Facilitating Higher-Order Thinking: Synthesizing Pedagogical Frameworks for the Development of Complex and Coherent Conceptual Systems

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ABSTRACT

Facilitating Higher-Order Thinking: Synthesizing Pedagogical Frameworks for the Development of Complex and Coherent Conceptual Systems

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This dissertation research investigates current practices in a cross-section of Canadian university education departments, in order to glean information about pedagogical approaches, subject matter, and classroom methods being utilized to support higher-order cognitive development. Courses for preservice teachers that dealt with subject matter related to higher-order thinking were examined through two qualitative empirical research studies, in order to find out what these students were learning about developing higher-order cognitive skills. Sixteen education instructors and fourteen students were interviewed, fourteen class sessions were observed in four courses, and sixty-seven students were surveyed, to solicit their views on learning and teaching with regard to complex networks of abstract ideas. Perceptions of outcomes, both favourable and unfavourable, were gathered. The results indicate that university education departments have implemented curricula that describe the cognitive elements, critical discursive processes, and learning theories that contribute to the development of higher-order thinking processes. However (according to the evidence described here), relatively little attention was paid to developing the philosophical perspectives, or the critical dispositions, that facilitate the creation and the maintenance of deeply and broadly

coherent frameworks of ideas. Three dimensions of higher-order cognitive learning are construed, and six pedagogical objectives are described that instructors can target to support their students' development of widely reflective and dynamic systems of coherent thought.

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1. Introduction

Purpose

The purpose of this research is to contribute to the improvement of the teaching of higher-order thinking in university education faculties, by examining current practices, and then proposing strategies and techniques that can support and facilitate higher cognitive development. This dissertation is designed to inform policy makers, educators and students on the state of the art of education with regard to the dynamic development of widely coherent cognitive/conceptual frameworks of understanding. Theories, tools and techniques for supporting advanced cognitive development are examined, and education instructors were asked to describe the methods that (in their experience) have produced the best results.

Since instructors at institutes of higher education seek to support their students in generating clear and comprehensive sets of ideas, this area of educational research should be of great interest to university faculty of all stripes, and especially to professors of education. This dissertation project investigates current practices in a cross-section of Canadian university education departments, in order to glean information about pedagogical approaches, subject matter, and classroom methods, have been used to support higher-order cognitive development. My intention is to promote recent developments in psychology and philosophy, in ways that can support other educators in their work; my mission is to demonstrate the pedagogical utility (or futility) of various approaches and methods with regard to teaching and learning complex sets of ideas. In particular, I targeted courses for preservice teachers that dealt with subject matter related to higher-order thinking, in order to learn what these students were doing to prepare themselves for their professional roles as mentors for young people who are developing their cognitive skills.

Specifically, I am investigating theoretical and practical questions involving the ways that people can learn to develop complex and coherent systems of thought. While it is widely understood that one of the most important purposes of higher education is to promote, support and facilitate higher-order cognitive development (including critical thinking, creative thinking and problem solving), there has been a great deal of controversy about how this aim can be achieved. While some theorists (e.g. McPeck, 1981) have claimed that thinking skills cannot be taught except in terms of domain-related conceptual analysis; others (e.g. Sternberg, 1987, 2001; Ennis, 1989; Paul, 1993; Lipman, 2003) have posited that thinking skills and dispositions should serve as subject matter for instructional practices.

In this dissertation I develop and evaluate a theoretical interdisciplinary pedagogical framework that is intended to support the intellectual development of higher-order conceptual frameworks. This model is built around the notions of metacognitive self-regulation (MSR), critical thinking (CT), critical dispositions, epistemological sophistication and dynamic (transformative) learning. To assess the utility of this integrative framework, I conducted interviews with a broad sample of faculty from Canadian university education programs to explore their perceptions of their curricula on these topics, and to examine their theories and practices with regard to facilitating higher cognitive development. I also produced a multi-case study of practices in one university's education department.

A New Theory of Mind

Donald (2002) claimed that, "We need a framework for learning that … goes beyond the acquisition of knowledge to encompass ways of constructing and using it in the disciplines" (p. xii). Carl Bereiter, in *Education and Mind in the Knowledge Age* (2002), has provided a highly erudite account of the justifications for the thesis that educators need to educate themselves in contemporary accounts of cognition. In particular, this author has claimed that "educational reform needs a new theory of mind" which enables educators to teach for the type of "deep understanding" that supports learners in coping with the ill structured problems that are encountered outside of schools. While he decries historical efforts to teach students how to think, he nevertheless holds out the promise that educators may indeed "contribute to students' lifelong ability to think productively" (Bereiter, 2002, p. 362).

As Bereiter points out, "The most basic of [educational] tools are our conceptions of mind and knowledge" (2002, p. 4). While folk theories have been adequate for many of our historical purposes, the theory of mind as a container of knowledge objects is insufficient to support the flourishing of future citizens. Current social problems are unlikely to be solved through historical knowledge; only by cultivating the disposition to investigate the world of conceptual artifacts (Karl Popper's "World 3"), and to construct their understanding of knowledge objects, can students be prepared to adapt continually and dynamically to the unpredictable circumstances which they will encounter outside of their classrooms.

In championing "progressive discourse" as the means by which learners and instructors deepen their understanding of understanding, this author warns that the reduction of knowledge to mere subject matter, activities, or self-expression devalues both individual understandings (Popper's World 2) and the socially constructed World 3 (theories, plans, models, etc.). He promotes the value of science as an exemplar of knowledge improvement; his commitments to fallibilism, constructive criticism, and nonsectarianism (Bereiter, 2002, pp. 87-88) stand as examples to any who wish to understand how knowledge may progressively be deepened.

Bereiter's pragmatic analysis of understanding is consonant with contemporary treatments of collaborative learning and situated cognition. He recommends that the teaching of conceptual tools can proceed in a way that is roughly analogous to the teaching of a motor skill (for example, skating on an ice rink): the learner must develop a relationship with the objects in question, must examine how they have been designed and used and how they relate to each other, and must discern how she or he must relate with them in order to produce desirable outcomes and avoid unwanted results. In this scheme, education is *acculturation* into the understanding and usage of conceptual objects, and the object is to learn to relate with these tools in such ways as to promote social flourishing.

While immersion in a background of facts and skills is acknowledged as a prerequisite for expertise in a given field, it is the implicit relationship of these facts and skills with each other, as embodied in an expert's analyses of problematic situations which enables and facilitates productive thinking. In practice, teams of experts, whose progressive and dynamic discourses are interdependently interwoven to elaborate potential solutions, are typically called upon to address the most difficult of problems. The metacognitive regulation of such conversations is provided by common historical understandings of concepts and theories with which the discussants are familiar; the background of social knowledge determines the validity of the justifications for any proposed solution. According to Bereiter, "We must … recognize that [the] ability to participate in and contribute to the success of progressive discourse … is a vital part of learning to be a thinker in the contemporary world" (Bereiter, 2002, p. 353).

Bereiter acknowledges that learning to think effectively may include cognitive training, which is especially useful in the remedial treatment of poorly trained learners, and he claims that wave after wave of educational reforms in the last century have been either reactionary ("back-to-basics") or cosmetic (administrative). Rather than improving the quality of teaching, what is needed is a transformation of the educational process, so that practices will be focused upon teaching for understanding. This "would mean organizing all aspects of the teacher education program so as to make the ability to teach for understanding definitive of teacher competence … The criterion for selecting expert teachers as mentors would be not only that they are good at teaching for understanding but also that they are actively engaged with problems of understanding" (Bereiter, 2002, p. 412).

While the "container theory" of mind permits the reduction of understanding to subject matter and activities, it does not allow for the "direct pursuit of understanding [which] is characteristic of real scholarship and science" (Bereiter, 2002, p. 436). On the other hand, contemporary theories of cognition and mind (which view the notion of mental content as metaphorical) describe our interactions with abstract objects of knowledge in ways that allow us continually to deepen our understanding of how they relate to us and to each other, so that we can use our discourses to produce more and better educational and social benefits.

Understanding these issues in cognitive development enables educators to provide access for their students to progressive and dynamic forms of discourse which, in practice, facilitate higher-order cognitive development and the construction of complex (yet coherent) conceptual frameworks. This thesis is intended to clarify these issues, and to describe these processes in action to illustrate their educational benefits.

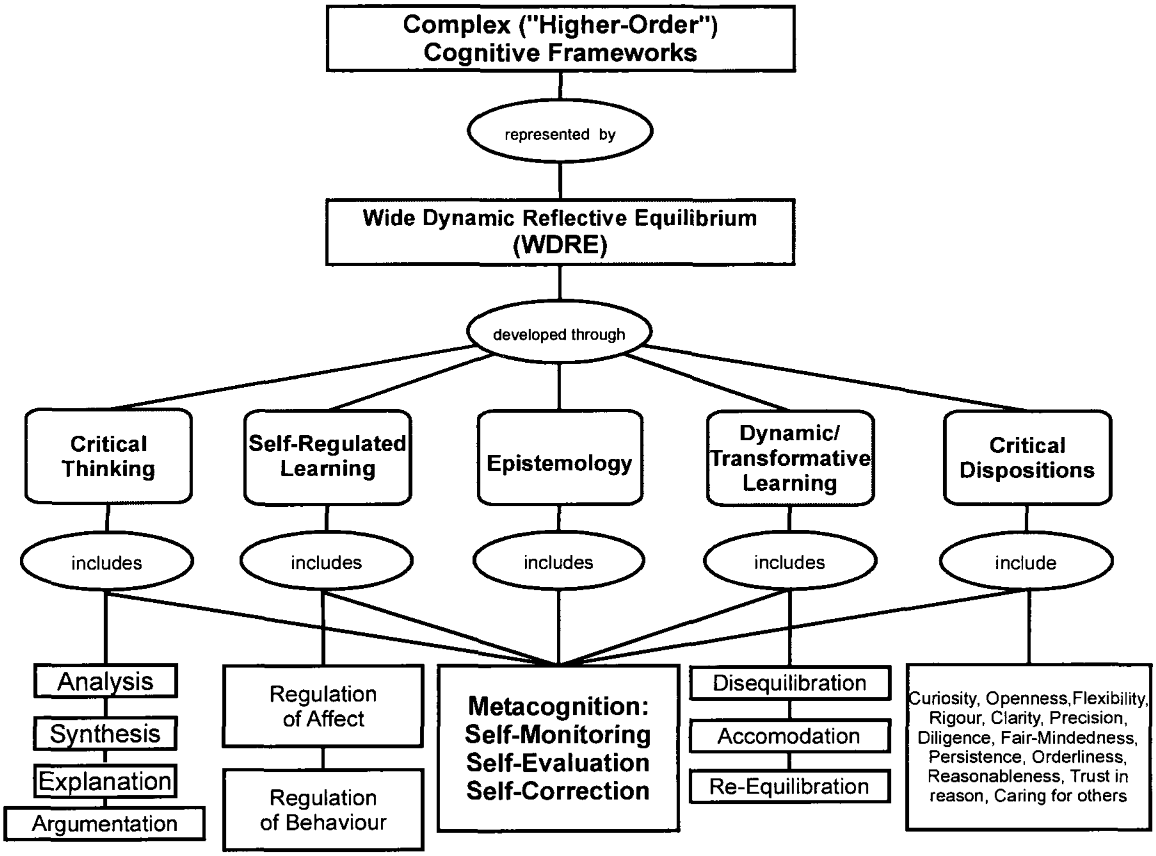
The Need to Teach Thinking Skills

Educational psychologist Robert J. Sternberg (1987) has recommended that thinking should not only be infused into school curricula as subject matter is being taught, but that explicit instruction in thinking skills should be provided at all levels of education. Sternberg points to three types of thinking skills (executive metacomponents, performance components, and knowledge-acquisition components), all of which must be integrated to support higher-order cognitive development. If optimal conditions for learning are to be met, then background knowledge and appropriate mental representations must be combined with the motivation to use thinking skills and with workable strategies for solving problems. "I believe that if a school system is serious about teaching thinking, it should dedicate special time to it, at the same time that workshops and seminars should be made available to all teachers so that they can reinforce rather than extinguish or even undermine what is being taught in the thinking skills curriculum" (Sternberg, 1987, p. 255). Furthermore, he points out the importance of evaluating student development as a function of cognitive skills, claiming, "A comprehensive formal evaluation should include … standardized thinking skill and intelligence tests, measures of achievement, measures of attitudes towards thinking and learning, measures of study habits, and the like" (p. 256).

Sternberg (2001) also claims that wisdom should be taught in schools, defining this construct as the application of tacit (as well as explicit) knowledge, as mediated by values, to achieve a common good through a balance of intrapersonal, interpersonal, and societal interests in both short and long terms to achieve a balance between (a) adapting to existing environments, (b) shaping existing environments, and (c) selecting new environments. He denotes sixteen principles for teaching wisdom, which include demonstrating the benefits of thinking outside of one's own needs and interests, role modelling, reading about wise judgments, teaching the use of independent thinking, recognizing other people's interests and acknowledging one's own values, thinking dialectically and dialogically, recognizing a common good, monitoring events and thoughts, and resisting undue influences.

Based on scholarly literature in the fields of education, cognitive psychology, and philosophy, I developed a pedagogical framework that integrates the psychological constructs of *critical thinking, affective dispositions, self-regulation* and *transformative learning* with the philosophical notion of *epistemological sophistication* (the awareness of how knowledge is well, or poorly, justified). The model is depicted in Figure 1; *wide dynamic reflective equilibrium* (Rawls, 1999), or WDRE, is a construct that describes broadly coherent systems of understanding.

Figure 1. A composite model of higher-order cognitive processes



To investigate the utility of this model, I interviewed sixteen education instructors who teach in universities across Canada, to ask them about their perspectives on the value of instruction in each of these topic areas, and about the methods and techniques that they have used to support their students' development of higher-order thinking. I also observed fourteen class sessions in four courses, surveyed sixty-seven students and interviewed fourteen of them, to solicit their views on learning and teaching with regard to complex networks of abstract ideas.

My intention is to create coherent descriptions of the manifold and complex teaching and learning processes that result from the interdependent interactions of students, teachers, and educational materials. Such descriptions should explain which approaches and techniques are more (or less) effective in various pedagogical situations, and are intended to support the work of educators whose objectives include providing interventions that are designed to facilitate their students' development of more and more complex sets of coherent ideas.

My Perspectives

My view of the pedagogy of higher-order and complex cognition holds that instruction in the subjects described above is essential with regard to understanding the notions of coherence and justification, and to appreciating the nature, and the limits, of human understandings. I believe that these are useful ideas for students of education to comprehend, to consider, and to apply in their discourses.

Since one aspect of qualitative research is controlling for researcher bias (and since all researchers are biased in various ways), I begin by acknowledging that I am an advocate of thinking skills instruction in schools. My own educational background has taught me that recently emergent theories in philosophy and psychology can support and facilitate the learning of complex cognitive processes, and my mission is to synthesize these findings and to advertise the pedagogical utility of various applications of these subjects with regard to learning, and teaching, complex sets of ideas.

Research Questions

To explore how pedagogical interventions designed to facilitate the development of cognitive skills have been implemented in education programs in Canada, this project is designed not only to describe recent research in this pedagogical area, but also to examine how Canadian universities have implemented the relevant theories and practices in their programs.

The research explores the following general question: From a pedagogical perspective, how can educators support the development of complex ("higher-order") and critical human cognition? In terms of ecological psychology, what *affordances* (including opportune theories, tools, and facts) may be provided to students to support their continuing development of higher-order thinking skills, and what *effectivities* (readiness to recognize and exploit affordances) can learners develop to facilitate analytical thinking and complex problem solving?

More specifically, the following research questions will be explored:

Which philosophical and pedagogical perspectives on instructional design and cognitive development are likely to facilitate higher-order intellectual development?

What empirical research has provided useful guidance for teaching and learning the processes of higher-order thinking?

A qualitative empirical investigation will explore the following questions:

What course materials, are currently being provided to education students in Canadian universities with regard to higher cognitive development?

How do the course materials provided to Canadian education students relate to contemporary research in this area?

What do Canadian university education instructors and students understand with regard to teaching and learning higher-order cognitive processes?

2. Literature Review

Cognition and Metacognition

Understanding Thinking

Since the aim of this work is to inform educators and policy makers at all levels of schooling, the following review of literature includes descriptions of what is needed to prepare elementary and secondary students for the complex cognition that may be developed during post-secondary education.

The past century has brought forth a great deal of research into thinking by philosophers, psychologists and educators; yet, the literature on the assessment of cognitive practices (which includes the explication of such philosophical variables as rationality, coherency, cogency, validity, soundness, and justification) exhibits a great deal of confusion with regard to the definition and the evaluation of cognitive skills.

Moseley, Baumfield, Elliot, Gregson *et al.* (2005), who reviewed dozens of theoretical frameworks for describing thinking, argue that "When a theoretical framework is used consistently and explicitly, it is likely that communication within an educational or training setting will be enhanced, as well as communication with the outside world" (pp. 296-297). To understand the difficulty more deeply, we may examine the following statement written by Peter Facione (1990), who led 42 educators (half of whom were philosophy professors) in a yearlong study of educational applications of the construct 'critical thinking' (CT). As a result of these efforts, Facione described six cognitive skills (explanation, interpretation, inference, analysis, evaluation, and self-regulation), broken down into 16 nominal sub-skills, and 19 "affective dispositions" (such as flexibility, intellectual honesty and inquisitiveness), which characterize the critical thinking process (for a total of 35 ostensibly distinct properties). Yet, even while describing this comprehensive scheme, the author took pains to distinguish his subject from several other forms of higher-order thinking, writing,

> The experts are clear on the point that not every useful cognitive process should be thought of as CT. Not every valuable thinking skill is CT skill. CT is one among a family of closely related forms of higher-order thinking, along with, e. g., problem solving, decision-making, and creative thinking. The complex relationships among the forms of higher-order thinking have yet to be examined satisfactorily. (Facione, 1990, pp. 12-13)

Understanding our judgements, and formulating methods for deciding what is valuable and what is negligible in our discourses, can allow us to provide prescriptive methodologies for analyzing our cognitive activities. Metaphilosophical consideration with regard to the best methods of dealing with problems can lead to systems for managing information in ways that lead to optimal results.

Scientists endeavour to construct coherent and insofar as possible predictive models of the underlying generative processes which give rise to all that we observe. This is a daunting task for the physical sciences and a much more daunting task for the psychological and social sciences. Insofar as education is an applied science, a technology to be more precise, it must make do with the best that the social sciences can currently offer it.

Project management is another form of problem solving, which has been designed to supervise resources, planning, and human performance in ways that are likely to lead to the successful execution of complex social activities. In this vein, we may develop methods for the development and maintenance of consistent judgements and evaluations in all our philosophical activities. Sidney Hook (1939) explained this scheme as follows:

> How does such a method proceed? Primarily by the clarification of meanings – a process in which their contexts are laid bare, their operational correspondences established, their implications and consistencies explored, their obscurities and ambiguities reduced … This is particularly true of the terms that are called basic or fundamental in special modes of inquiry, and of almost all terms which express evaluations and appraisals. (p. 39)

Dewey warned, "[A] n act of controlled inquiry demands a rich background and a disciplined insight" (1939, p. 263). When comparing values, the development of clear standards is paramount. Standards of value must be distinguished from standards of measurement; the latter provide methods for dealing with physical facts, the former specify how to assess individual (qualitative, abstract) ideas. Judgements of value rely on the qualities of individual assessments (of objects, events or situations). While our standards cannot be universal (since our judgements are relational), they may provide baselines, guides for comparing ethical, epistemic and aesthetic assessments.

In the last half of the twentieth century, psychologists and educators picked up on philosophical examinations of rationality, and they began to employ sets of terms that were intended to characterize the nature of effective thinking. In the 1950s, Benjamin Bloom (1956) described cognitive processes in terms of knowledge, comprehension, application, analysis, synthesis and evaluation; since that time, a great deal of educational effort has been expended on attempts to clarify the workings of these (and other theoretical) processes, in order to facilitate the teaching and learning of practical and effective cognitive functioning. Many educators have worked to establish the relationships of these processes, and have described the possibility of teaching thinking skills in academic settings.

The recent revision (Anderson, Krathwohl, Airasian, Cruikshank, *et al.*, 2001) of Bloom's taxonomy of cognitive skills includes *creation* as the skill of producing new ideas and expressions from historical understandings; Facione (1990) and his associates specified *explanation* as a higher-order cognitive skill; Ennis (1989) included social interaction skills, including argumentation, as an important focus for instruction. Thus we may conclude that higher-order thinking includes abilities to articulate and to express our most coherent assessments and conclusions.

Robert Ennis (1962, 1987, 1989, 1998) has spent over 40 years on this project. In his early (1962) paper on the subject, Ennis distinguished three dimensions (aspects or facets) of critical thinking, including logic, domain-specific criteria and practical applicability. According to this formulation, the purpose of critical thinking is to arrive at "correct" assessments of discursive statements. The critical thinker evaluates justifications to decide whether a statement is meaningful and warranted; arguments are evaluated for self-contradiction and ambiguity. Ennis (1987) provided a taxonomy of critical thinking dispositions and abilities (including fourteen dispositions and twelve abilities), and he defined CT as "reasonable reflective thinking that is focused on deciding what to believe or do" (p. 10). He remarked that Bloom's taxonomy includes "lower" cognitive skills (knowledge recall, comprehension and application) as well as the "higher" functions of analysis, synthesis and evaluation; he also pointed out that (at that time, 17 years ago) the higher functions had never been clearly described, and we lacked criteria for assessing their applications. Ennis (1989) focussed on the question of "subject specificity," coming out in favour of the pedagogical generalizability of critical thinking skills, and concluding, "Under the general approach, the appropriate balance between emphasis on principles which are applied to content and emphasis on abstract principles depends at least on the nature of the content, the critical thinking dispositions and abilities being promoted, and the students. This balance must be determined empirically" (p. 4).

The Delphi Committee of the American Philosophical Association (Facione, 1990, as described in the Introduction above) has described six skills (including 16 "sub-skills") and 19 dispositions, which they (more or less consensually) regard as being associated with critical thinking, namely:

COGNITIVE SKILLS AND SUB-SKILLS

1. Interpretation: Categorization, Decoding Significance, Clarifying Meaning
2. Analysis: Examining Ideas, Identifying Arguments, Analyzing Arguments
3. Evaluation: Assessing Claims, Assessing Arguments
4. Inference: Querying Evidence, Conjecturing Alternatives, Drawing Conclusions
5. Explanation: Stating Results, Justifying Procedures, Presenting Arguments
6. Self-Regulation: Self-examination, Self-correction

(p. 6)

and

APPROACHES TO LIFE AND LIVING IN GENERAL

- inquisitiveness with regard to a wide range of issues
- concern to become and remain generally well-informed
- alertness to opportunities to use CT
- trust in the processes of reasoned inquiry
- self-confidence in one's own ability to reason
- open-mindedness regarding divergent world views
- flexibility in considering alternatives and opinions
- understanding of the opinions of other people
- fair-mindedness in appraising reasoning

- honesty in facing one's own biases, prejudices, stereotypes, egocentric or sociocentric tendencies
- prudence in suspending, making or altering judgments
- willingness to reconsider and revise views where honest reflection suggests that change is warranted

APPROACHES TO SPECIFIC ISSUES, QUESTIONS OR PROBLEMS

- clarity in stating the question or concern
- orderliness in working with complexity
- diligence in seeking relevant information
- reasonableness in selecting and applying criteria
- care in focusing attention on the concern at hand
- persistence though difficulties are encountered
- precision to the degree permitted by the subject and the circumstance

(p. 13)

Examining this array of skills and attitudes reveals the difficulty of the task facing educators who intend to teach their students how to think critically. In particular, the willingness to adopt the nineteen dispositions described may be seen to limit one's capacities to apply the cognitive skills of analysis, evaluation, and self-regulation (skills which seem to distinguish highly effective thinkers from those who are untrained in the effective application of these practices). Thus teaching cognitive skills may be of little avail unless the learners are committed to adopting commitments to (most or all of) the above dispositions. The teaching of critical (including self-critical) attitudes, then, may be seen as essential to CT instruction.

Matthew Lipman (2003) has presented a detailed and cogent analysis of educational applications of research into higher-order thinking, writing, "If we want to foster and strengthen critical thinking in the schools and colleges, we would do well to keep in mind the persistent concerns to which it has been addressed. We also need a clear conception of what critical thinking can be. Therefore, it will be very useful to know its defining features, its characteristic outcomes, and the underlying conditions that make it possible" (p. 209). Lipman concludes, "[C]ritical thinking is *thinking that (1) facilitates judgment because it (2) relies on criteria, (3) is self-correcting, and (4) is sensitive to context*" (p. 212, original emphasis). Criteria involved in CT include conventions, rules, standards and values, which must be analysed in terms of their applicability to problematic discourses. Self-correction is paramount, and "One of the most important advantages of converting the classroom into a community of inquiry … is that the members of the community begin looking for and correcting each others methods and procedures. Consequently, insofar as each participant is able to internalize the methodology of the community as a whole, each is able to become self-correcting in his or her own thinking" (p. 219; here we may see how the dispositions to diligence, fair-mindedness, clarity, etc. may be encouraged). The fourth characteristic, context sensitivity, includes recognition of exceptional circumstances and acknowledgment of the limits of applicability of rules and guidelines.

Lipman emphasizes the products of critical thinking (judgments) as the focus of this process; in particular, CT is the exercise of "good judgment." Judgments are likely to be good "if they are the products of *skillfully performed* acts guided or facilitated by appropriate instruments and procedures … This involves more than attaining understanding … It involves using knowledge to bring about reasonable change. Minimally, the product is a judgment; maximally, it is putting that judgment into practice" (p. 211, original emphasis). This approach highlights the practical applicability of CT in action.

Richard Paul and Linda Elder (2002) have bemoaned the failure of social institutions to emphasize the value of critical thinking skills. "Great power is wielded around the world by little minds. Critical thinking is not a social value in any society" (p. 5). These authors distinguish "weak" from "strong" critical thinking; the former applies to egocentric (self-centred) thought processes, while the latter refers to "fair-minded" cognitive analyses, those which consider multiple viewpoints, including those that are contradictory to the thinker's historical points of view.

Paul and Elder have done an excellent job of describing critical thinking skills in relation to discursive practices. They elaborate upon the purposes involved in CT (including the achievement of clarity, significance, consistency and justifiability), and they stress the possibility of the reconciliation of various points of view (which requires flexibility and breadth of vision). In addition to the requirement for confirmation of the accuracy of information used in inquiry, they describe the need for the clarification of the concepts and the assumptions (as well as the implications) used by any line of thought, and they acknowledge the importance of validation of inferences and interpretations, which follow from a line of reasoning.

Paul and Elder also explain how critical thinking applies to decision-making. Effective and rational decision-makers are aware of (and are able to re-evaluate) their "most fundamental goals, purposes, and needs" (Paul and Elder, 2002, p. 149); they describe situations and alternative courses of action as precisely as they can, and they consider the consequences and the implications of each alternative. They actively seek relevant information, which they analyze and interpret carefully, evaluating each option in the light of circumstances, and adopting an appropriate strategy, which considers all of the above. Finally, competent decision-makers monitor and evaluate the consequences of their actions, and are ready to modify their analyses and change their strategies as more information becomes available.

Mogenson (1999) expands the idea of critical thinking to include epistemic, transformational, dialectical, and holistic thinking.

> [C]ritical thinking aims at identifying and challenging what is in existence, simply because it exists. This means, among other things, recognizing that what exists is always encapsulated in cultural and historical contexts. Critical reflections should reach an understanding of how these contexts have influenced the thinker. From this basis, critical thinking should develop the ability to imagine alternatives and propose possible modes of action. Critical thinking is visionary thinking. (Mogenson, 1999, p. 432)

Harvey Siegel (1980, 1988, 1991, 1997) has supplied a comprehensive review of theories of CT, along with a perspicuous analysis of the pedagogical implications of recent research. Siegel has done a thorough job of analyzing Ennis', Lipman's and Paul's contributions (along with those of many others), and he has provided an excellent guide through the intellectual morass of skills, sub-skills, dispositions, attitudes and tendencies which are attributed to those who characteristically produce good judgments. Siegel's work concentrates on controversies surrounding the generalizability of CT, with regard to both its philosophical and pedagogical considerations; he provides a view which eschews epistemic relativism and which promotes a fallibililistic and inclusive vision of consensual rationality.

Siegel grounds CT in the modern epistemic tradition, which holds that informed rational analyses of controversial issues approach closer to the truth as more and more evidence is generated. Thus he champions the generalizability of epistemology and rationality, and he describes the necessity for fundamental rules and assumptions, which are universally applicable. In order for CT to be possible (on Siegel's analysis), we must accept the premise that "reasons are good reasons if (and only if) they afford warrant to the claims or propositions for which they are reasons … There are all sorts of good reasons – causal, inductive, explanatory, purposive, deductive, etc. – but they all share this crucial epistemic feature" (Siegel, 1997, p. 322). Thus epistemology (and critical thinking) are generally involved with the study of warrant, of what counts as a good reason in whatever circumstances may be under consideration. While different criteria apply to reason assessment in different circumstances, or in different fields of study, the same rationale nevertheless applies to all critical analyses: CT involves focussed inquiry as to the nature, the quality, and the applicability of reasons for (or against) belief and action; thus CT relates closely to the ideas of justification and social legitimation.

Siegel acknowledges the importance of dispositional traits and attitudes, to which complex set of structures he assigns the term "critical spirit"; he holds that this (inquiring) attitude is fully generalizable across fields of study. Siegel focuses on the possibility of communicating the critical spirit while fostering critical skills in the classroom, and he describes various methods for doing this. For example., he promotes the use of philosophical novels as tools for critical instruction; he describes Dostoevsky's *The Brothers Karamazov* (which is rich in philosophically-disposed characters) to illustrate the instructional value of calling attention to the plights of fictional people. Students identify with the problems, personalizing the various issues involved; critical inquiry is facilitated through this process in ways, which cannot occur through (for example) the instructional practice of explicating philosophical fallacies.

Siegel makes the point that CT is about justification, rather than truth; when evidence points to a particular conclusion, critical thinkers are obliged to accept that conclusion (regardless of its "ultimate" truth). While, in the long run, we are more likely to reach more true conclusions by relying on evidentiary justification, we must also accept that available evidence sometimes misleads even the most astute of thinkers; as the author argues, "a well-educated student/person is one who is, at least, *appropriately moved by reasons*" (Siegel, 1997, p. 49).

Halpern (1998) has bemoaned the failure of "college students and the American public in general" (p. 449) to apply the faculties of critical cognition to justify their beliefs (in, e. g., paranormal phenomena). She states, "Naïve and flawed reasoning practices … are resistant to change because they make sense to the individual, and, for the most part, the individual believes that they work" (p. 449). She points out that a national consensus in the United States led both the first President Bush and his successor to declare critical thinking education a national priority for college students. With the electronic age having resulted in a widespread availability of a great deal of information, it is more important than ever that people be taught to discriminate better (that is well-justified) beliefs from those that are highly suspect (due to a lack of coherent justification).

According to Halpern (1998), "Higher order skills are relatively complex, require judgment, analysis and synthesis, and are not applied in a rote or mechanical manner. Higher order thinking is thinking that is reflective, sensitive to the context, and self-monitored ... The goal of instruction designed to help students become better thinkers is transferability to real-life, out-of-the-classroom situations" (p. 451). Williams (1999) notes that thinking skills should not only be taught in classrooms, but also assessed.

> [H]igher-order cognitive constructs must be definable and assessable in the context of processes and outcomes that regularly occur in the classroom (e.g., class discussions, teacher-made tests, and student projects). Applying curriculum-based assessment to higher-order thinking would first require a detailed analysis of the particular skills involved in higher order thinking. These skills would be transformed into specific objectives ordered from most basic to most advanced. Using this approach, teachers could assess student progress on a hierarchy of higher-order thinking skills. Progress would be assessed in terms of both the nature and quantity of thinking skills mastered. (Williams, 1999, p. 423)

Metacognition

Flavell (1979) distinguished *metacognitive knowledge* as ideas and beliefs about our cognitive processes (including ideas about ourselves, other people, learning tasks and strategies), and he described the idea of *metacognitive experience* as "any conscious cognitive or affective experiences that accompany or pertain to any intellectual exercise" (p. 906). Metacognitive knowledge directs how we manage our intellectual tasks, and assesses how likely we are to be successful, while metacognitive experiences affect which goals we choose, and whether we persist in achieving them (or not). Bandura (1977) described *self-efficacy* (including *efficacy expectations* and *outcome expectations*) as a set of psychological variables, which relate to successful (or unsuccessful) learning, and Bandura (1986) elaborated the metacognitive self-regulatory mechanisms (self-observation, judgment of performance, and self-reaction), which affect learning processes.

According to Bandura (1986), self-observation (or self-monitoring) does not simply refer to noticing what occurs, but is closely involved with judgment and self-reaction, since we may monitor the quality of our learning performance and the rate at which we are learning. Such observations relate to our prior standards of performance, providing the data for self-judgment and self-reaction. Bandura noted that high self-monitoring is associated with high motivation for the task, and monitoring that is more proximate to the task is more useful for learning than that which is removed in time. Judgments of one's performance relate to internal standards, which are the product of social influences (either modelled by others or directly taught); and the "development of evaluative standards and judgmental skills establishes the capacity for self-reactive influence" (Bandura, 1986, p. 350).

Facione's (1990) Delphi Committee elaborated a similar scheme, describing two self-regulation "sub-skills," namely *self-examination* and *self-correction*. Self-examination refers to a complex set of processes, which include the following abilities:

> … to reflect on one's own reasoning and verify both the results produced and the correct application and execution of the cognitive skills involved ... to make an objective and thoughtful meta-cognitive self-assessment of one's opinions and reasons for holding them … to judge the extent to which one's thinking is influenced by deficiencies in one's knowledge, or by stereotypes, prejudices, emotions or any other factors which constrain one's objectivity or rationality… [and] to reflect on one's motivations, values, attitudes and interests with a view toward determining that one has endeavored to be unbiased, fair-minded, thorough, objective, respectful of the truth, reasonable, and rational in coming to one's analyses, interpretations, evaluations, inferences, or expressions. (Facione, 1990, pp. 10-11)

Facione (1990) describes self-correction as the ability to react to errors revealed by self-examination, and specifically to "design reasonable procedures to remedy or correct, if possible, those mistakes and their causes" (p. 11). Bandura (1986) devotes considerable attention to the "self-reactive influences" involved in self-regulation, and his social cognitive analysis of the processes involved in self-correction should be of considerable interest to professional educators. Indeed, Bandura notes, self-observation not only "provides the information necessary for setting realistic performance standards and for evaluating ongoing changes in behaviour" (Bandura, 1986, p. 337), but it also serves as a dynamic source for new information that affects action and adaptation. In particular, self-analytic and self-diagnostic processes help us to learn about our affective and cognitive reactions to various types of events, and such efforts are instrumental in determining the conditions under which we perform well or poorly. Furthermore (as recommended by Neuringer, 1981), "By systematically varying things in their daily lives and recording the accompanying personal changes, people can discover how these factors influence their psychological functioning and sense of well-being" (Bandura, 1986, p. 338). Also, self-observation contributes to self-motivation, as, "Goal-setting enlists evaluative self-reactions that mobilize efforts towards goal attainment … A number of factors, some relating to the persons, others to the behavior, and still others to the nature and type of self-monitoring can affect the likelihood that observing how one behaves will enlist self-reactive influence" (Bandura, 1986, p. 338).

Bandura (1986) provides an extensive set of descriptions of self-judgemental and self-reactive functions, and of the influences that are involved in the psychology of self-regulation. Judgment is closely tied to the development of individual standards, acquired through social modelling. Aside from ideal and theoretical standards, Bandura notes that comparison with others provides a convenient basis for self-judgment, and that it is important for students to recognize the value of performing to high social and academic standards (rather than being content with expending less effort by emulating the results of their less accomplished peers). He points out that an important part of self-evaluation is the development of appropriate norms, with regard to one's social group, and also taking into account one's previous performance in the milieu. Other influences on self-reaction include the valuation of the activities being learned, with high valuation being associated with maintaining or increasing one's welfare and self-esteem. "Thus, the more relevant one's performances are to one's sense of personal adequacy, the more likely self-evaluative reactions are to be elicited in that activity" (Bandura, 1986, p. 349). Self-reaction is also affected by the perception of the determinants of one's behaviour; causal attribution of success to our own abilities and to effort expended, rather than to external factors over which we exert less control, results in greater self-satisfaction.

Bandura warns. "[I]nternalization of dysfunctional standards of self-evaluation can serve as a source of chronic misery" (Bandura, 1986, p. 357). Indeed, to be most effective, educators must attend to the metacognitive functions which support the maintenance of coherent frameworks of ideas, whether our ideas concern the content of academic disciplinary subjects, or whether they are associated with more general human concerns (such as maintaining our social relationships, or applying for a job). Sternberg (1987) argues that schools should prepare students for life by teaching cognitive skills, including knowledge acquisition skills, performative skills, and metacognitive self-regulation. To succeed in higher learning, students must learn to combine these types of learned abilities; they must use workable learning strategies, they must develop "appropriate" mental representations of things and processes in the world, and they must be motivated to use these thinking skills.

Aulls and Shore (2008) point out, "Forms of traditional instruction are not likely to promote students to learn to be inquirers … Students are expected to be passive more than active learners who acquire factual and conceptual knowledge by hearing it or seeing it rather than thinking and doing" (pp. 15-16). These authors recommend that *inquiry* be treated by educators as a curricular imperative, and that teachers use inquiry-based and student-centred methods in their practices. "In order to be engaged in inquiry learning... [i]nstruction must be more centred on the learner than the teacher ... For students to become more active learners, they must take on more responsibility for what and how to learn" (p. 9).

Academic and practical understandings of metacognition and metacognitive self-regulation (MSR) are essential to educators and to educational researchers in facilitating instruction in the definition and resolution of complex and ill-defined (academic or practical) problems. One aim of research in metalearning and metacognition is to raise the awareness of teachers and students with regard to the relevance of metacognitive functions to learning and cognitive development; eventually, the use of metacognitive self-regulatory functions may become well-understood, and widely spread, throughout our schools and our workplaces.

Empirical Research on Teaching Thinking

In a recent effort to discover which instructional interventions, and under what conditions, are effective in facilitating the development of critical thing (CT) skills and dispositions, Abrami, Bernard, Borokhovski, Wade, Surkes *et al.* (2008) systematically reviewed over 3700 abstracts of papers, and retrieved 1300 articles and reports for closer analysis. Applying the method of quantitative meta-analysis to extract information from empirical research reports, we analyzed one hundred seventeen articles (dated from 1953 to 2003) that contained enough statistical data for us to calculate, or to estimate, effect sizes (in terms of Cohen's d, the mean difference between two groups divided by the pooled standard deviation). Some papers reported the results from more than one comparison, and we calculated one hundred sixty-one effect sizes that examined CT skills (or dispositions) from experimental, quasi-experimental, and pre-experimental studies. These comparative results ranged from +2.90 to –1.36 (where negative effect sizes indicate that control group scores were, on the average, higher than those of the treated group). There were one hundred thirty-seven positive effects, and twenty-four negative ones, and the mean of these effect sizes (without weighting by sample size) was +0.569. This section presents a qualitative review of the twenty papers that produced the ten highest, and the ten lowest, effect sizes with regard to CT skill development, comparing the features of each of these studies with one another, in order to see whether any pedagogical or methodological features tend to predominate in the "successful" studies (those with high positive effect sizes). A qualitative review of the attributes of the reported interventions may reveal some features of the successful intercessions that distinguish them from the unsuccessful ones. In the following sections I will summarize these studies, evaluate their study features, and discuss their relevance; in addition, I will draw some general conclusions about the difficulties faced in drawing general conclusions about such endeavours.

Review of Twenty Selected Studies

Studies with Positive Effect Sizes

1. Annis and Annis (1979) showed that Ethics students significantly outscored Introduction to Philosophy students and the Control class in Deduction and Interpretation, and that Logic students significantly outperformed the other three groups in Inference, while no significant differences were found in Recognition of Assumptions, or Evaluation of Arguments. Since only post-test mean scores were provided, Abrami *et al.*'s calculations did not take pre-test scores into account, and our comparison of the

results indicated that Logic students outperformed the Control subjects by a margin of nearly three standard deviations (d = +2.91).

2. McCarthy-Tucker (1998) reported that high school freshman and sophomore students in English and Algebra who received instruction in formal logic showed much greater improvement (from pre-test to post-test) on two standardized measures of thinking, the Test of Logical Thinking (TLT) and the Content Specific Test of Logic (CSTL), than untreated control subjects (d = +2.54 and d = +0.59, respectively).

3. In a pre-experimental (one group pre- and post-test) study of inservice teachers, Robinson (1987) worked with eighteen educators on encouraging their elementary (kindergarten to grade three) students to think interpretively, reflectively and intelligently, and to acknowledge complexity. The teacher training program emphasized using questioning to encourage thinking, modelling (personifying listening, problem-solving, calmness, understanding and enthusiasm), and facilitating logical thought. Teachers' mastery of CT teaching skills was evaluated by trained observers according to classroom performance, assessed by checklist which included fourteen ratings, nine of which were provided in an appendix (apparently five were inadvertently omitted): fosters a climate of openness, encourages student interaction/co-operation, demonstrates attitude of acceptance, models reasoning strategies, encourages transfer of cognitive skills to everyday life, elicits verbalization of student reasoning, probes student reasoning for clarification, encourages students to ask questions and promotes salient reflection of ideas. Raw pre- and post-test scores for each participant were provided, and they showed

significant positive gains in mastery of teaching thinking skills; gain scores in this pre-experimental paradigm translated to an effect size of $d = +2.50$. As far as the teachers' elementary school pupils were concerned, statistical measures were not calculated, but pre- and post-evaluation summary results of thinking skills tests (knowledge, comprehension, application, analysis, synthesis and evaluation) were provided, and positive gains were reported.

4. Zohar, Weinberger and Tamir (1994) developed the Biology Critical Thinking Project to support seventh grade biology students in Israel in developing their CT skills (which included recognizing logical fallacies, distinguishing between experimental findings and conclusions based on findings, identifying tacit and explicit assumptions, avoiding tautologies, isolating variables, testing hypotheses, and identifying relevant information). Random control trials were used to test the efficacy of the program on two dependent variables developed for this study, a general CT test (administered before and after the training) and a biology CT test (post-test only). Average scores were reported for nearly five hundred students, and the results were highly favourable for the program, as experimental students registered higher average gain scores on the biology CT test ($d = +2.32$), and also outperformed the control group on the general CT test ($d = +2.09$).

5. Marzano (1989) reported the results of the Tactics for Thinking program for elementary school, high school and community college students in the United States. The program was designed to teach the following twenty-two thinking strategies: attention control, deep processing, memory frameworks, power thinking, goal setting, the

responsibility frame, concept attainment, concept development, pattern recognition, macro-pattern recognition, synthesizing, proceduralizing, analogical reasoning, extrapolation, decision making, evaluation of evidence, evaluation of value, elaboration, nonlinguistic patterns, everyday problem solving, academic problem solving, and invention. Reported results (mostly quasi-experimental, comparing treated and untreated groups of students) were favourable; Abrami *et al.* were able (given published t values) to estimate five positive effect sizes, ranging from +1.68 to +2.31, for the following skills: analogical reasoning (ninth grade), extrapolation (grades seven and ten), examination of value strategy (grade eleven), and decision making strategy (grade ten). Although sufficient data was provided only for these five effect size calculations, the Marzano study also reported many other statistically significant comparisons between treated and untreated groups; of twenty-six such comparisons, only one did not produce a significant gain for the treatment group in comparison to the respective control group.

6. Using a quasi-experimental design, Riesenmy, Mitchell, Hudgins and Ebel (1991) taught self-directed critical thinking to 70 fourth and fifth grade students in St. Louis public schools. They expected that students who were taught the roles of four modes of thinking (task definer, strategist, monitor and challenger) would perform better on a problem solving post-test which demanded both lateral and vertical transfer of thinking skills. This prediction was fulfilled by the results. Three groups of treated students outscored the control group; the group who wrote immediate post-tests had greatly superior scores on average ($d = +2.30$); a second group tested four weeks later outscored the controls ($d = +2.00$), and a third group, tested eight weeks later, also

outperformed the control students (d = +0.68). Thus, while the effects of critical thinking training were immediately evident, the benefits seemed to degrade over time.

7. To test the effects of problem based learning on the development of medical students' critical thinking skills, Kamin, O'Sullivan, and Deterding (2002) used digital video case simulations followed by group discussions as an instructional method. One group of students who viewed the cases on video discussed the case online, a second group saw the videos and discussed them face to face, while a third group received a text account of the case (rather than a video) and participated in face to face discussions. Content analysis of the discussions was used to assess critical thinking demonstrated by each group; results showed that, video presentation seemed to facilitate critical thinking, and the online discussion group scored highest, outperforming the text group by a wide margin (d = +2.20). The authors suggested that the online discussion format provided better opportunities for the students to concentrate on articulating their ideas.

8. In a study conducted by Champion (1975) for his doctoral dissertation, ninety-seven fourth grade students in Pennsylvania received short-term instruction in distinguishing fact from inference; two quasi-experimental comparisons between treated and untreated groups demonstrated significantly higher gains (d = +2.15 and d = +1.40) in treated students' scores on the Van Pit Thinking Test.

9. Feuerstein (1999) investigated the effects of a Media Literacy program, which was intended to teach primary school students in Israel to be critical of media advertising. The

instruction included activities connected with defining and researching problems, decision-making, drawing conclusions and verifying conclusions. The dependent variable for the quasi-experimental design was a language and media test, administered before and after the four month training course, and the results showed a large increase in average scores for the treatment group, with only a slight increase for untreated control group students (d = +2.10).

10. Daley, Shaw, Balistrieri, Glasenapp, and Placentine (1999) used the construction of concept maps (as recommended by Novak and Gowin, 1984) as a method for both the teaching and the assessment of critical thinking. Fifty-four nursing students were taught to create concept maps (diagrammatic representations of conceptual frameworks showing hierarchical organization and specifying links between ideas) as part of their training in clinical practice; their early efforts were compared with their third assignment at the end of the semester-long course. Eighteen cases were selected for analysis, and a significant improvement (d = +1.90) was recorded from the first assignment to the last, which the authors claimed was "indicative of the students' increase in conceptual and critical thinking" (Daley *et al.*, 1999, p. 45).

Studies with Negative Effect Sizes

11. In an attempt to promote CT skills in community college students studying microbiology, Norton (1985) withdrew all instructional support in laboratory work from an experimental group (except for safety supervision). While a control group worked in pairs and were guided by the instructor in following the lab manual (which gave step-by-step instructions for identifying an unknown bacterial culture), the "independent study"

group worked without instructor support, selecting procedures to be performed, performing the procedures, and interpreting the results. (All students followed the manual for the first few weeks of the term to learn the procedures, and the manual was always available to the treatment group). After three weeks, the control group outperformed the experimental group on the Watson-Glaser Critical Thinking Appraisal (WGCTA) by a small margin ($d = -0.18$). Norton suggested that the WGCTA might not be sensitive to increased CT skills in this setting, that learning styles may have accounted for unmeasured influences on results, and that the treatment may have been too short in duration to have had a measurable effect.

12. Stekel (1969) also developed a program of independent study in a physical sciences laboratory setting, which offered an intact experimental group of freshman non-science majors the opportunity to select the topics that they would study, and to design their own experiments. A control group underwent a conventional program that assigned a particular experiment each week; each group was pre- and post-tested using alternate forms of the WGCTA. While the author reported that both groups increased their CT scores (at the statistical significance level of $p < 0.10$), the control students' average gain (3.78 points) was higher than that registered by the experimental group (2.13 points), which translates to an effect size of $d = -0.22$.

13. Using the California Critical Thinking Skills Test (CCTST) as their dependent variable, and employing a quasi-experimental design, Arburn and Lowell (1999) tested the idea that training in question generation would lead to improvement in CT. Two

intact community college classes in Human Anatomy and Physiology were studied; the experimental group was taught to apply a set of generic question stems to construct questions on the subject matter. This technique was meant to facilitate complex thinking, and the results indicated that both groups of students (thirty-seven control and thirty-one experimental subjects) scored slightly higher on the post-test; however, the control group gained 1.27 points, compared to 0.29 points for the treated students ($d = -0.24$).

14. Kemp and Sadoski (1991) used training in the appropriate formation of generalizations in attempting to increase the critical thinking of high school history students. Two intact groups of eleventh grade world history students were compared, after one class received specific training in explicit methods of forming cogent generalizations. While the authors reported no significant difference between pre- and post-test Cornell Critical Thinking Test scores, the means indicate that both groups achieved lower scores on the post-test compared with their pre-test performances. The experimental group showed a decrement of 4.47 points, while the control students scored 1.75 points lower ($d = -0.28$).

15. In attempting to teach analogical reasoning to approximately one hundred fifth and seventh grade students, Hartman-Haas (1984) used the Children's Association Responsing Test to assess this skill in children who had been taught a "holistic approach to improving thinking" (which included training in thinking, listening, remembering, reading, writing, speaking, active class participation, attitudes, clarification, logic and argumentation). The program lasted seven months, and post-test results (compared with

matched groups who had not received the training) indicated that, while treated grade seven students scored significantly higher than their control group ($d = +0.59$), untrained peers outscored fifth grade students who had participated in the program ($d = -.34$). The author speculated, "Seventh grade students may have had more highly developed abstraction skills than fifth graders, which may be important for consolidating and demonstrating gains from programs which emphasize the development of higher-order thinking skills" (p. 20). She also pointed out that the Grade Five class suffered from a (traumatic) interruption in their studies after their teacher was injured in a traffic accident.

16. Moffett (1998) evaluated CT through the analysis of writing samples provided by students of eighty-seven teachers in Indiana who taught grades eight through twelve. In this study, teachers were provided with a monthly set of study materials and a study guide, which were designed to promote critical thinking through activities in visual, performing, and literary arts. Two cohorts of the treated teachers' classes, and two sets of control classes (approximately one thousand seven hundred students), provided pre- and post-test essays for assessment, and the results were uniformly negative; post-test average scores for all four groups were lower than pre-test performances, and in one of the two comparisons the experimental subjects showed a greater decrement than controls ($d = -0.37$).

17. Ennis, Finkelstein, Smith, and Wilson (1969) attempted to teach conditional logic to elementary school students (grades one, two and three) by presenting fifteen audiotaped lessons in as many weeks. Each tape presented a lesson in logical thinking associated

with various problem-solving tasks, and was intended to teach an aspect of using conditional logic; post-tests (the Smith-Sturgeon Conditional Reasoning Test, created for the project) assessed the children's thinking skills in the areas of inversion, conversion, contraposition and transitivity. Contrary to expectations, students exposed to the lessons performed no better at the logic tests than control groups for each grade level (and the grade two control participants scored much higher than their treated counterparts, $d = -0.48$). The researchers concluded that the training they had devised was inadequately effective under the circumstances.

18. Saucier, Stevens and Williams (2000) studied one hundred twenty nursing students in Texas who were taking a course in Nursing Care of the Family. Random assignment to control and experimental groups allowed for the latter to perform clinical case studies through simulations using computer-assisted instruction (CAI), while the control group participated in the "traditional written nursing process" for fifteen weeks. While neither process was described in detail, both were reported to include the following steps: Assessment, Nursing Diagnosis, Client Goals, Planning Intervention, Actual Intervention and Evaluation of Goal Attainment. All students were pre- and post-tested using the CCTST, and the authors reported that the experimental treatment was not a significant predictor variable in a multiple regression of post-test results. Mean scores indicated that the control group outperformed the CAI students on the CCTST ($d = -0.52$).

19. Gibbs, Brown and Keeley (1988) reported surprising and discouraging results of their attempt to educate fifty university faculty members in critical thinking skills. Faculty

from twenty-five departments at University of Wisconsin Eau Claire participated in a development program that was designed to "alert faculty to the need for a greater focus on higher order cognitive thinking in their classrooms" (p. 3). The program included discussing critical thinking skills and attitudes, teaching styles for facilitating CT, self-assessment of CT engagement, and pedagogical methods consistent with CT objectives. In a random control experimental design, twenty-two faculty members who had applied to the program were designated as untreated controls, and after six four-hour training sessions over two semesters, the experimental group scored lower than the control subjects on the Ennis-Weir Critical Thinking Test (EWCTT; $d = -0.66$). The authors, in attempting to explain the results, pointed out that, given all the planned activities, "it was impossible to build into the training sufficient time for faculty to practice critical thinking activity" (p. 13). They also noted that the EWCTT is limited in its scope (concentrating on the identification of reasoning fallacies), and may be inappropriate for measuring a "broader concept" of CT. They suggested that "compensatory rivalry" might have motivated the control group (who "may have resented" their exclusion from the program) to take more care in responding to the test.

20. To test the effects of an inquiry-based nursing education program on CT development, Magnussen, Ishida, and Itano (2000) used pre- and post-testing on the WGCTA as a dependent variable. One hundred fifty nursing students at University of Hawaii were tested at admission and at graduation, before and after undergoing a four-year program of case-based inquiry learning, where clinical groups of eight to ten students and a faculty member discussed what was known about the cases being treated,

identified clients' needs, and decided how those needs could be met. The authors reported no significant change in the group's average CT scores overall; however, when the cohort was divided in three groups based on their pre-test scores (low, medium, or high), a spectacular example of regression to the mean was evident: the low-scoring group increased their average by close to half a standard deviation (d = +0.40), while the high-scoring group scored lower than they had originally (d = -1.36), and the middle group also lost some ground (d = –0.80). The authors postulated that the test, administered at the end of the program, may have been unimportant to the students, and that they may not have made a wholehearted effort, but this does not explain why the initially low-scoring group managed to increase their scores.

Study Features

Tables 1 and 2 present a number of demographic, methodological and pedagogical features of interest to anyone who interprets this research in terms of the educational processes and outcomes that were involved. The features selected for presentation here seem to be among the most salient ones (in terms of connecting processes and outcomes) that are generally reported in reports and dissertations (type of publication is shown in Table 2). The following subsections provide brief explanations of each feature, along with my interpretations of their potential relevance for relating processes and outcomes in the context of these twenty examples. According to Abrami *et al.*, Studies 1 to 10 produced the ten highest effect sizes (calculated from descriptive data presented in the original reports, or estimated on the basis of statistical calculations originally presented); in contrast, Studies 11 to 20 produced the poorest results (considering that the purpose of all this research is to increase CT scores).

Table 1. Studies reviewed, showing education levels, type of interventions, dependent measures, and effect sizes

Study No.	Author(s)	Year	Education Level	Instruction	Instrument	Cohen's *d*
1	Annis & Annis	1979	College	Logic	Watson Glaser CT Appraisal	2.9072
2	McCarthy-Tucker	1998	High School	Logic	Test of Logical Thinking	2.5433
			High School	Logic	Content Specific Logical Thinking	0.5897
3	Robinson	1987	In-Service Teachers	Thinking Skills	Fourteen observed behaviours	2.5002
4	Zohar et al.	1994	Grade 7	Thinking Skills	Biology thinking skills test	2.3207
			Grade 7	Thinking Skills	Thinking skills test	2.0850
5	Marzano	1989	Grade 7	Thinking Skills	Exploration strategy	2.3081
			Grade 10	Thinking Skills	Decision making	1.9364
			Grade 11	Thinking Skills	Value strategy	1.9200
			Grade 10	Thinking Skills	Exploration strategy	1.6951
			Grade 9	Thinking Skills	Analogical reasoning	1.6778
6	Riesenmy et al.	1991	Grades 4 and 5	Thinking Skills	Problem solving	2.3018
			Grades 4 and 5	Thinking Skills	Problem solving	1.9998
			Grades 4 and 5	Thinking Skills	Problem solving	0.6761
7	Kamin et al.	2002	Medical School	Video Case Simulations	Discourse analysis	2.1957
8	Champion	1975	Grade 4	Thinking Skills	Van Pit Thinking Test	2.1501
			Grade 4	Thinking Skills	Van Pit Thinking Test	1.4017
9	Feuerstein	1999	10 to 12 years old	Media Literacy	Language and media test	2.0694
10	Daley et al.	1999	Nursing School	Concept Maps	Case analysis	1.8967
11	Norton	1985	Community College	Independent Study	Watson Glaser CT Appraisal	-0.1778
12	Stekel	1969	University	Independent Study	Watson Glaser CT Appraisal	-0.2185
13	Arburn & Bethel	1999	Community College	Questioning Skills	California CT Skills Test	-0.2439
14	Kemp & Sadoski	1991	Grade 11	Forming Generalizations	Cornell Critical Thinking Test	-0.2790
15	Hartman-Haas	1984	Grade 5	Thinking Skills	Association Responsing Test	-0.3444
			Grade 7	Thinking Skills	Association Responsing Test	0.5888
16	Moffett	1998	Grades 8 to 12	Teaching Guide	Writing skills	-0.3720
			Grades 8 to 12	Teaching Guide	Writing skills	0.1010
17	Ennis et al.	1969	Grade 2	Conditional Logic	Conditional Reasoning Test	-0.4765
			Grade 1	Conditional Logic	Conditional Reasoning Test	0.0200
			Grade 3	Conditional Logic	Conditional Reasoning Test	0.0194
18	Saucier et al.	2000	Nursing School	Computer Case Studies	California CT Skills Test	-0.5213
19	Gibbs et al.	1988	University Faculty	Thinking Skills	Ennis-Weir CT Test	-0.6573
20	Magnussen et al.	2000	Nursing School	Inquiry-Based Learning	Watson Glaser CT Appraisal	-1.3590
			Nursing School	Inquiry-Based Learning	Watson Glaser CT Appraisal	-0.7959
			Nursing School	Inquiry-Based Learning	Watson Glaser CT Appraisal	0.3954

Table 2. Studies reviewed, showing publication type (J – journal article, R – professional report, D – doctoral dissertation), treatment duration and instructor training

Study No.	Education Level	Instruction	Effect Size	Publ. Type	Duration of Treatment	Instructor Training
1	College	Logic	2.9072	J	1 semester	Instructors in Philosophy
2	High School	Logic	2.5433	J	4 months	Graduate students in Education
	High School	Logic	0.5897		4 months	Graduate students in Education
3	In-Service Teachers	Thinking Skills	2.5002	R	9 months	Faculty trainer
4	Grade 7	Thinking Skills	2.3207	J	school year	24 hours
	Grade 7	Thinking Skills	2.0850		school year	24 hours
5	Grade 7	Thinking Skills	2.3081	R	3 class periods	4-5 days
	Grade 10	Thinking Skills	1.9364		3 class periods	4-5 days
	Grade 11	Thinking Skills	1.9200		2 class periods	4-5 days
	Grade 10	Thinking Skills	1.6951		3 class periods	4-5 days
	Grade 9	Thinking Skills	1.6778		2 class periods	4-5 days
6	Grades 4 and 5	Thinking Skills	2.3018	J	12 lessons	2 hours
	Grades 4 and 5	Thinking Skills	1.9998		12 lessons	2 hours
	Grades 4 and 5	Thinking Skills	0.6761		12 lessons	2 hours
7	Medical School	Video Case Simulations	2.1957	R	1 week	Medical school faculty
8	Grade 4	Thinking Skills	2.1501	D	12 lessons (18 hours)	Doctoral student in Education
	Grade 4	Thinking Skills	1.4017		12 lessons (18 hours)	Doctoral student in Education
9	10 to 12 years old	Media Literacy	2.0694	J	4 months (30 hours)	Trained instructor
10	Nursing School	Concept Maps	1.8967	J	1 semester	Trained instructor
11	Community College	Independent Study	-0.1778	R	3 weeks	Microbiology instructor
12	University	Independent Study	-0.2185	R	1 semester	Physical sciences instructor
13	Community College	Questioning Skills	-0.2439	R	1 semester	Anatomy/physiology instructor
14	Grade 11	Forming Generalizations	-0.2790	J	2 weeks	Trained instructor
15	Grade 5	Thinking Skills	-0.3444	R	5 months	Trained instructor
	Grade 7	Thinking Skills	0.5888		7 months	Trained instructor
16	Grades 8 to 12	Teaching Guide	-0.3720	R	1 semester	Physical science instructor
	Grades 8 to 12	Teaching Guide	0.1010		1 semester	Physical science instructor
17	Grade 2	Conditional Logic	-0.4765	R	15 weeks (15 lessons)	Audio Tutorials
	Grade 1	Conditional Logic	0.0200		15 weeks (15 lessons)	Audio Tutorials
	Grade 3	Conditional Logic	0.0194		15 weeks (15 lessons)	Audio Tutorials
18	Nursing School	Computer Case Studies	-0.5213	J	1 semester	Trained instructor
19	University Faculty	Thinking Skills	-0.6573	R	8 months (24 hours)	Faculty trainer
20	Nursing School	Inquiry-Based Learning	-1.3590	J	4 years	Program faculty
	Nursing School	Inquiry-Based Learning	-0.7959		4 years	Program faculty
	Nursing School	Inquiry-Based Learning	0.3954		4 years	Program faculty

Author and Year of Publication

No author is involved in more than one of the twenty studies under consideration, which clearly indicates the lack of a pattern with regard to this feature. Comparing the dates of publication of the top ten studies with the bottom ten reveals no clearly discernible difference in effectiveness of more recent, or less recent, interventions; the fact that the two oldest studies (both from 1969) produced negative effect sizes is counterbalanced by the relatively recent appearance of studies 13, 16, 18, and 20.

Education Level

Here the distribution of elementary school and post-graduate interventions seems to be evenly distributed across both halves of the list (Table 1); however, the list is top-heavy with secondary school studies (four in the first half, two in the second), and weighted towards the bottom with research on university students (two in the first ten, five in the rest). This result is consistent with those of Abrami *et al.*, who reported that quantitative analyses of studies of elementary and secondary school students averaged significantly higher effect sizes (Hedges g, weighted for sample size, of +0.52 and +0.69 respectively) than university students ($g = +0.25$); average g for interventions at the post-graduate level was +0.62. These results may lead an inquirer to wonder why educational interventions to support CT development seem to have been least effective at the undergraduate level.

Type of Intervention

Table 1 shows that, of the top ten studies, seven delivered explicit instruction in the development of deductive logic or other cognitive skills (analysis, evaluation, inference, assumption testing, etc.), and the other three interventions seem also to have been closely related to this particular topic. Study 7 concerned medical students analyzing cases; Study 9 coached students in the critical analysis of media advertising; and Study 10 promoted the cognitive skills applied in the development of cognitive maps.

As far as the other ten studies are concerned, Hartman-Haas (1984, Study 15) reported partial success, as seventh grade students benefited from thinking skills instruction. Study 17 was unsuccessful in teaching conditional logic skills to early elementary school students through audiotaped lessons, while Study 19 demonstrated that university faculty members don't always benefit demonstrably from professional development programs which are intended to support them in developing their thinking skills. While the unsuccessful interventions were intended to promote CT, at least two provided no instruction whatsoever in the subject (the two articles on Independent Study).

We may infer that direct instruction in thinking skills benefits performance on tasks that are designed to test these skills. Of course, this accords with intuitive reason, especially with regard to short-term retention, and it also seems obvious that long-term practice of complex analysis, assumption testing, evaluation, inference, problem-solving, argument and explanation leads to long-term retention of these skills. Abrami *et al.* reported that CT "immersion" (indirect teaching of cognitive skills without specific explanations of these skills) produced the lowest average effect size ($g = +0.09$) compared with direct instruction in generic CT ($g = +0.38$), infusion of direct instruction along with other subject matter ($g = +0.54$), and mixed instructional methods ($g = +0.94$).

Dependent Measures

Just as a wide variety of effect sizes is evident in the reviewed studies, so is a wide variety of thinking skills tests, and results measured by standardized tests in the Abrami *et al.* study are not as high as those measured by teacher-created assessments; average *g* for the latter was +1.43, compared to +0.24 for the former. Table 1 bears out this result; seven of the bottom ten studies used standardized CT tests as their dependent measure, and two used other thinking tests, while eight of the top ten used teacher-developed measures.

To interpret this result, there are several factors that can be taken into account. Since the instructor is proximate to the instruction, she or he is well qualified to create assessment instruments that are closely related to the class material. Unless the instructor is specifically tailoring instruction to a standardized measure (which is certainly a possibility), the unfamiliarity of a standard test instrument, and its indirect relation to the subject matter of instruction, provides a less favourable performance environment. Researchers ought to consider the likelihood that teachers have a vested interest in assessments that demonstrate successful educational achievement, and this bias may (and perhaps should) lead to the development of student-friendly assignments and examinations. Standard tests, of course, are not specifically designed to reflect students' (or their teachers') educational accomplishments.

Another possibility (as raised by Gibbs *et al.*, 1988, Study 19, by Norton, 1985, Study 11, and also by Magnussen, 2000, Study 20) is that CT tests do not measure the complex skills used by expert thinkers; an inspection of these tests makes it obvious that they examine only the most basic of analytic and inferential skills, rather than more complex and dynamic cognitive functions (such as metacognitive self-regulation and explanation). Complex problem solving and explanatory skills are highly relevant to higher-order thinking in all disciplines, and these functions are not directly addressed by standard tests of generic thinking skills.

Treatment Duration

Table 2 indicates that no pattern emerges from duration data; successful interventions range from nine months to very little instruction time (mere exposure of medical students to video cases and online discussions produced remarkable results in the first week, and two or three class periods of instruction resulted in leaps of thinking skill by secondary school students), while unsuccessful ones lasted eight months and four years. Abrami *et al.* declined to report any results on this measure, as we could arrive at no clear interpretation of the quantitative analysis. It seems intuitively obvious that the quality of an intervention is more salient to the outcomes than its duration, and (as mentioned above) high-quality long-term instruction seems more likely to produce long-term benefits than high-quality instruction of short duration.

Publication Type

Six of the top studies were published as journal articles; seven of the last ten appeared as reports to professional organizations (Table 2). While this does not demonstrate that journal articles provide better data (or even that they describe better interventions), it is in line with the idea that journals are more likely to publish studies that accomplished their stated research goals (*publication bias*).

Instructor Training

While we may presume that all of the instructors in these twenty sets of interventions were qualified to teach their classes, it is obvious that they varied in their training and their experience with regard to understanding and applying higher-order cognitive skills to their work. The last column in Table 2 presents what I could glean from the research report descriptions of the specific training received by the instructors in these interventions. Where "trained instructor" is listed, the reports mentioned only that the teachers received some training prior to the implementation of the teaching involved; where a number of hours is listed, the report stated how long the training lasted. The rest of the articles did not mention any teacher training, so I have simply mentioned the positions of the instructors.

Abrami *et al.* reported that studies which mentioned instructor training had a higher average effect size ($g = +1.00$) than the others; sub-groups ranged from $g = +0.13$ (where CT was simply stated as a course objective) to +0.58 (where extensive observations of curricular activities were described). On this measure, five of the top ten studies mentioned that instructors received specific training for the intervention (and four of the others were led by experienced instructors or graduate students in education); three of the last ten mentioned special instructor training. While this result should be interpreted with caution (since not all instructor training is effective instructor training), it stands to reason that instructors who are well trained in the arts and science of higher-order thinking are in a better position to teach these skills to others.

Instrument Failure

Since critical thinking is a highly complex construct, and since a wide variety of measures have been deployed to assess thinking skills, the issue of instrumentation is central to research in this area. The crucial question here is how researchers should deal with this tangle of sub-constructs and the plethora of operational measures. When measuring thinking skills, is it best to use standard measures, locally produced tests, or both? While the last choice may be best for research purposes (indeed, it sometimes seems that the more dependent measures we can cram into a research design, the more information we can gather, and the better off we are), practical concerns do not always allow for many options, and there is always the problem of selecting from standard tests, or of designing new ones. Psychometric issues such as this may entail great complexity.

Should meta-analysts compare results of educational interventions when the outcomes are measured on highly variant types of instruments? It might be better to analyze results of interventions measured by one type of assessment, rather than comparing quantitative results derived from unrelated instruments; however, we can draw conclusions only from whatever data is available. Thus, meta-analysts can only hope that enough (well designed, well controlled and well described) studies will soon be published, in order that sufficient numbers of comparisons will be available to inform us about which interventions, applied in which ways, with which students, produce consistently beneficial results for which well-defined set of thinking skills measured by a particular type (or means) of assessment.

As for the variety of instruments which are available, or might be created, we may infer (or hope) that most of them fulfil their specific purposes, namely to measure particular sets of cognitive skills. However, unless these skills are well and publicly defined, and the instruments themselves are published, consumers of research cannot evaluate the utility of the tests. For systematic reviewers to make sense of the empirical literature, the skills being tested, and the instruments used to measure the performance of these skills, must be well described by research reports. It also seems that a great deal of effort must be invested if we are ever to establish the specific value of applying any measure in one context or another.

Limits of Reporting

Research reports are wonderful in their variety; it sometimes seems that the number of reporting styles published in educational journals is equal to the number of authors who produce the reports. From quantitative analyses rife with descriptive and inferential statistics (and hardly a nod to any theoretical idea involved in the project), to thick descriptions without a digit (or a Greek letter) in view, educational scholars produce many thousands of reports each year, and the job of selecting the best of these from the least utile ranges from difficult to impossible. Yet all share a shortcoming: They are static, coarse-grained representations of weeks (or months, or years) of participation by some number of individuals, and the processes (cognitive, affective, or educational) which are undergone by all of the people involved in an educational research study cannot be captured in a research report.

The bane of the meta-analysts with whom I have discussed this issue is the retrieval of a well-designed study, with clearly defined interventions, experimental and control groups, good theoretical grounding, and appropriate operational measures, but lacking a crucial bit of statistical data (e. g., standard deviations) which disqualifies it from inclusion in a meta-analytical review. While such difficulties may be irritating, even a study that contains adequate statistical data for effect size calculations may not provide enough information about the process so that reviewers can possibly extract enough descriptive features from the report to account for the conditions of the treatment. Since meta-analysts are concerned not only with the magnitude and the direction of any experimental effect, but also with methodological, pedagogical, demographic and contextual features of the experimental setting (so that they can account for variables which promote, or mitigate the effects), the best studies (for the purpose of producing clear meta-analytical results) are those that provide both complete statistics and many rich descriptions of the setting. Unfortunately, it seems that only a small proportion of research reports are both statistically complete and thick with description. Here researchers are faced with the hope for a large and general improvement in the quality of educational research.

Unmeasured Variables

While many educational research projects ask learners to rate the interventions in which they participated, such self-reports (most often delivered at the end of the project) may not closely reflect the attitudes that determined the qualities of each participant's interactions with the instructor, the content material, the pedagogical methods, and his or her classmates. Moreover, each individual's motivational networks (including, but not limited to, self-efficacy, self-regulation, task value, and competing demands outside of the project) may not be well represented in their summative evaluations of a course, an instructor, or a method. While inter-individual differences (including learning styles and prior knowledge) are generally acknowledged to influence learning outcomes, and while quantitative theorists hope that large-sample random control trial experiments can be designed to obviate such factors, it seems that a) individual and group psychodynamics, which affect operational learning outcomes such as achievement and satisfaction measures, are unlikely to be measured (in the foreseeable future) with sufficient levels of precision for their variability to be taken into account through statistical measures, and b) it is extremely difficult to test educational interventions through the use of large-sample random control trials.

It is possible that the most salient variables in determining the outcomes of educational processes are psychological, dynamic, and emergent (rather than pedagogical, static, or reducible to one-dimensional measures). The feelings, attitudes and commitments brought to the classroom by each participant, the collective organization of these personalities, and the changes in these basic human motivational factors during the course of a lesson, a day, or a school year, can only be described in the most qualitative of terms. We cannot measure abstract constructs such as "motivation," "self-regulation," "reflection", or "collaboration," and our operational measures that relate to such terms may currently be considered inadequate to fulfil our research purposes. If this is the case, then researchers should recognize that we need better tools than have been available to date, and that educational research programs should be organized in ways that will enable the systematic analysis of reports of assessments of particular interventions.

Using Educational Technology to Teach Thinking

Computer-Assisted Instruction

As Lajoie (2000) pointed out, "[L]earning theories can guide the design of computer-based learning environments that provide cognitive tools for learners" (p. xvii). Lajoie and Azvedo (2000) concluded,

> Computer-based environments ... provide more authentic contexts for studying scientific reasoning ... [I]ntelligent systems can observe patterns in tool use, and researchers can draw appropriate inferences regarding learner understanding from such patterns ... These rich instructional and assessment platforms , when joined with traditional cognitive methodologies of verbal protocol analyses of students dialogues, can add to our understanding of learning, reasoning, and problem-solving practices. (p. 267)

Kester, Kirschner, and van Merriënboer (2005) studied the effects of screen design on the process of learning the functions of electric circuits. In the context of cognitive load theory, these researchers presented circuit diagrams and their associated textual descriptions in two distinct formats to high school students, who were randomly assigned to two groups. In the control condition, a circuit diagram was presented on the left side of a split screen, while a textual description was on the right; experimental subjects saw a single diagram, with text boxes integrated into the circuit diagram. Cognitive load theory predicts that a *split attention effect* should result in lower scores for students who were presented with the split screen condition, since cognitive resources for members of this group would be drained by a greater effort required to integrate the textual information with the diagram, while the integrated text format would carry less (extraneous) cognitive load. After nine practice problems and ten test problems, it was found that experimental subjects scored significantly higher on transfer test scores, which supports the hypothesis that this group found the task easier to complete due to a lesser degree of extraneous cognitive load. Research such as this contributes to our understanding of how instructors and instructional designers can support their students in learning to deal with complex data.

Hulshof, Eysink, Loyens and de Jong (2005) studied the use of interactive computer-based learning modules (called ZAPs) to facilitate the learning of psychology by university students, and by students who were enrolled in higher vocational training. The ZAPs were designed to present textual information with regard to the principles, evidence and applications of psychological phenomena and processes (e. g., stimuli, responses and associations characteristic of classical conditioning). In addition, they provide for a discovery activity which allows the user to manipulate the elements involved in the lesson; in the example of classical conditioning, a user can schedule the virtual presentation of stimuli (a light, a bell, and a food reward), and is then presented with the resultant measure of the dependent variable (a picture of a dog salivating and a graph of the measurements of salivation over the time). Using random assignment and a two-group experimental design, removal of the discovery component from one group's ZAPs was not associated with lower post-test performance; however, the authors nevertheless concluded (on the evidence of superior long-term retention by the group that had access to the discovery activity) that the discovery activity supports understanding of the lesson's psychological principles. In addition, Hulshof *et al.* noted that students and teachers evoked a rare enthusiasm for this instructional tool, because it provided for a rich, hands-on learning experience.

Graesser, McNamara, and VanLehn (2005) reviewed three computer-based learning environments (CBLEs), which they developed in order to facilitate deep comprehension, metacognition, inquiry, and explanatory skills. These tools (*Point&Query, AutoTutor, and iStart*) were designed as tutoring agents, on the basis of two learning theories: Vygotskian social learning (which emphasizes the importance of cognitive scaffolding and feedback), and the Piagetian notion of cognitive disequilibrium, which postulates that learning environments should be designed to create dilemmas. In particular, these authors emphasize the cultivation of *question-asking skills*, lamenting the infrequency of classroom inquiries and the shallow character of most student questions, so they have designed their electronic tutors both to model and to encourage the production of deep questions.

Point&Query is described as a "hypertext-hypermedia system with the augmentation of a question-answering and asking facility" (p. 227). Designed for high school and university students, this application presents a list of questions on a topic, and the learner points and clicks on these to be presented with the answers. Results of research showed that students preferred asking shallow questions, but a controlled experiment demonstrated that students could be prepared beforehand to inquire deeply by pre-assigning a difficult task (one which required deep thinking about cause and effect) prior to the tutoring session.

AutoTutor engages learners in a dialog, and elicits complete explanations of observed phenomena (e. g., in physics). An animated head (complete with facial expressions) prompts students for information, provides hints and assertions, and (when all else fails) supplies answers to facilitate the process.

A third tool described by Graesser *et al.*, iStart, supports adolescents and young university students in monitoring and evaluating their comprehension as they read, providing instruction on reading strategies (comprehension monitoring, paraphrasing, bridging inferences, prediction and elaboration), posing questions, and providing information. Specific training in strategy use is provided (modeled on screen by animated characters), and the system provides feedback to the learners as they integrate prior knowledge and prior text with the current content.

Graesser *et al.*'s review of the evidence, which they have gathered to date on the utility of their tools, is favourable; this is to be expected, given the careful attention that they have devoted to producing and testing them. At the least, it would seem that such efforts are laudable, and it is possible that these (and similar) applications will provide great benefits to generations of future students.

White and Frederiksen (2005) have used CBLEs to support young learners in developing metacognitive expertise in the context of learning communities. They note that group collaboration and reflective learning, combined with appropriate scaffolding from technology tools and human tutors, support not only the development of self-regulatory skills, but also *developmental expertise*, "expertise about how you improve your capabilities through inquiry and reflection" (p. 211). The software environment *Inquiry Island* was developed to support learning through a cycle of inquiry which includes developing a research question, generating hypotheses, designing an investigation, recording and analyzing data, creating a model, and evaluating the utility and the limitations of the model. Software agents (*advisors*, such as *Quentin Questioner, Ivy Investigator*, *Sydney Synthesizer, Pablo Planner, Molly Monitor, Keiko Collaborator* and *Manny Mediator*) support each step in the cycle, prompting the students to think about each part of the process, and to evaluate their progress as they proceed. As an adjunct to this process, students also participated in group discussions to analyze novels they had read, and took turns acting the roles of the twelve cognitive, social and metacognitive advisors (including theory manager, evidence manager, synthesis manager; collaboration manager, planning manager, etc.). They were then asked to reflect on their experiences of playing these roles, and to write about the purposes of cognitive, social and metacognitive regulation. Quantitative measures (in the absence of a comparison group) showed significant gains by students in researcher assessments of metacognitive skills and inquiry skills, and the researchers claim that enjoyment of the role-playing exercise had "important motivational ramifications" (p. 221). While pre-experimental or quasi-experimental research does not provide evidence for causal claims of the effectiveness of interventions, it stands to reason that metacognitive scaffolding, such as White and Fredericksen have described, can be of great benefit in the development, internalization and proceduralization of self-regulatory skills, and that the use of tools such as Inquiry Island can support the development of self-regulation by providing explicit instruction in metacognitive performance.

Quintana, Zhang, and Krajcik (2005) bring a disciplined approach to metacognition and self-regulated learning (SRL) to bear on their analysis of CBLEs, which have been designed to facilitate online searches (*Artemis*, *Digital IdeaKeeper* and *Symphony*). Their theoretical framework, derived from contemporary literature on the theory of SRL, includes three sets of metacognitive functions (foresight factors related to task understanding and planning; monitoring and regulation; and reflection) applied to four types of cognitive activities (asking questions, searching, evaluating and synthesizing). The authors addressed the features of the various software packages in terms of how they support each of the metacognitive functions: understanding the inquiry task and planning the process, monitoring and regulating the inquiry process, and reflecting on different aspects of the work. They conclude "software can help make the implicit nature of metacognition more explicit to learners" (p. 242), and they propose that computer-based scaffolding can be organized around metacognitive issues.

Fischer, Troendle and Mandl (2003) pointed out that, although elementary and high schools have benefited greatly from investment in web-based learning technologies, university education has "largely remained unaffected" (p. 194) by the advent of these tools, and (to aid the process) they have introduced five guiding principles derived from empirical studies on technology-based learning environments. In the context of "problem-oriented environments" (p. 195), these principles are *authentic problem contexts*, *collaborative knowledge construction* (including the integration of alternative perspectives), *tools to represent the problem* and the domain concepts involved, *learning resources* (including expert advice), and a *tutor* to guide the process (without supplying answers to the problem under discussion). The authors and their colleagues created a dynamic modelling and visualisation tool (called MUNICS) to aid in developing the design specifications for a virtual computer network, and graphics tools were provided to facilitate problem definition and resolution. A formative evaluation of the prototype was conducted, using a one-group pretest-posttest design, with the participation of eleven computer science students who worked in groups of two or three. In addition to knowledge of computer networking (assessed before and after a two-hour working session), the students completed questionnaires about their experience with the tool, and their acceptance (on a Likert-type scale) of the learning environment. The questionnaire results were mixed (as might be expected from an initial implementation), demonstrating some dissatisfaction with user-friendliness, functionality and usability, but indicating favourable ratings for collaborative learning and problem-oriented learning. While the authors claim that the quality of the end products of the collaboration was "rather high" (p. 207), and while "rather modest" (p. 207) improvements were measured in knowledge of network design, the pre-experimental design of this study does not allow for cause-effect conclusions. In general (given that functionality and usability can always be improved), this particular set of results may encourage the development of this particular tool, and similar ones as well.

Dickey (2005) presented a comprehensive analysis of the use of 3D virtual worlds (interactive virtual reality combined with messaging in a desktop computing environment) as educational tools, with particular attention to design features that facilitate learning. In examining *Active Worlds Educational University* and *Adobe Atmosphere*, Dickey explored the notion that "learners construct understandings by interacting with information, tools, and materials as well as by collaborating with other learners" (p. 124). He compared the two software packages in terms of their interfaces and their educational implications, and he described the particular resources and tools that they each provide to facilitate the construction of communicative discourses and to support their users' experiences of learning. While the author's descriptions of these learning environments makes clear that opportunities for content creation, cognitive development, and collaboration are restricted by the practical constraints imposed on users (including the difficulty of constructing new objects, and the limits to the modalities of computer communication), nevertheless we may infer that there are advantages, especially for young learners, of creating a virtual identity and learning to collaborate in the interactive construction of knowledge in an environment reserved for educational (or combined educational and recreational) use. In particular, Dickey makes the important point that technological tools do not determine the effectiveness of educational relationships, which instead emerge from how the tools are used. "It is important to note that within a constructivist paradigm of learning, technology tools do not evoke the characteristics of a learning community, but rather these dynamics are the result of the interplay between content, the instructor, and the learners" (p. 132).

MacGregor and Lou (2005) studied the use of WebQuest by fifth-graders, in order to examine the effects of the use of concept mapping tools on recall and on the production of multimedia presentations. WebQuest is an online problem-solving environment, which provides introductions to problems, the tasks themselves, resources, procedures, assessment criteria, and conclusions.

The fifth-grade students used WebQuest to create presentations for second-graders; they each selected an endangered species of animal, and gathered information about their subject to be organized in a slide show. Half of the students were assigned at random to receive an instructional aid, a concept-mapping template, which specified connections to be made between sub-topics and which served as a basis for designing the presentation; the other half were required to develop their own storyboards. Upon completion of the task (the production of which was closely monitored by the researchers, who analyzed each performance in detail), quantitative results demonstrated significantly higher scores awarded to the experimental (concept-mapping) group for both presentation content and organization; this group also demonstrated higher recall when reporting what they had learned. In reporting these results, MacGregor and Lou advise, "[I]t is important for teachers to be cognizant of the design features within a site and understand how they facilitate student use in achieving learning objectives. Design features that provided support for the students included *appropriate discourse readability, high content relevance, easy navigation, user-friendly screen design, and multimedia*" (p. 172; emphasis added).

WebQuest is apparently a very useful technological tool for supporting content learning using learner-centred methods and a problem-based approach to instruction. This application is designed as a "higher-order use of technology" (MacGregor and Lou, 2005, p. 172), in that it prompts students to search widely for information, and to integrate their findings into comprehensive problem solutions. While there is no question about the utility of WebQuest's application to well-structured tasks, as it can supply the means to solve algorithmic problems (and this capacity is quite useful to inexperienced learners), we might question its applicability to situations where problems and their expected solutions are not well defined. Creating a presentation from existing materials may be considered an open-ended task, in that the structure of the final solution is not fully predetermined; however, more ill-structured problems (which require a more heuristic approach), may require complex analysis and synthesis of information from a variety of sources even to define which parts of the problem are more or less amenable to resolution. While computer tools have not yet been devised to support the development and maintenance of the most highly complex and dynamic reflective conceptual frameworks, we may look forward to the production of more and more intelligent CBLEs.

Winn (1993) described the educational value of virtual reality (VR) applications, concluding that constructivism provides a basis for a theory of learning in virtual environments. Examining "immersive VR," where the interface between machine and user is transparent, Winn pointed out that learning in VR shifts from third-person (vicarious, objective, explicit) knowledge to the attainment of direct, personal and subjective first-person understandings. This type of experience allows for non-symbolic problem solution, which can later be integrated with third-person descriptions. Winn praises the educational capabilities of VR, claiming that it allows us to create knowledge from direct experience, bypassing the symbol systems, which represent other people's formulations while we construct our own learning from direct interaction with virtual objects. VR offers unique educational advantages (allowing us to resize objects for close study, to transduce information to perceivable forms, and to reify abstract objects and events), and the conversion of traditional third-person educational practices into first-person events has demonstrated clear benefits in many applications (e. g., in complex simulations used to train airline pilots, astronauts and supertanker captains).

Notar, Wilson and Montgomery have developed a framework for instructional design (ID) that focuses on the development of higher-order collaborative cognition through distance education (DE). While we might question their premise that ID should make DE "no different than learning in the traditional classroom" (par. 1), their conclusions with regard to effective ID seem to be cogent. Notar *et al.* stress the value of hypermedia as a tool that allows for traditional educational activities (experiments, demonstrations, and personal participation) to be enacted in new ways (although one might argue that the resemblance of hypermedia applications to corporeal interactions is superficial, or even that hypermedia can sometimes allow for superior learning opportunities). Describing games and simulations, they remark on their value in engaging learners and thus promoting motivation, and they address how technological developments can facilitate the development of higher-order thinking by embedding instruction in the dynamic experience of social participation (always facilitated by an instructor who exemplifies excellent judgment in applying principles, using information, and executing procedures). Sharing and dialogue are instrumental in this process, which encompasses both synchronous and asynchronous opportunities for conversation. Notar *et al.* listed ten design factors which contribute to the effectiveness of the learning process and resulting cognitive growth; these include "rich" learning activities, presentation of multiple perspectives and multiple links between ideas, continual self-assessment by all learners, exposure to expert performance, and collaborative work on highly complex problem scenarios. Although these authors do not distinguish between ID work at different levels of education, and they do not consider the specific disciplinary content of educational objectives, the general principles that they promote are consistent with contemporary ideas about learner-centred and problem-based instructional methods. Of course, instructors are always faced with figuring out how to increase their skills in applying such theoretical generalities to particular lessons.

Azevedo (2005a) described the relationships of metacognition, self-regulated learning (SRL), and hypermedia learning tools, claiming that SRL provides a useful theoretical framework for guiding the study of learning with hypermedia. Pointing out that SRL theory has been developed to describe how we learn to deal with the complex and dynamic functions which characterize higher learning, and that five psychological processes associated with SRL (planning, monitoring, strategy use, control and motivation) provide access to the operational variables needed to study higher-order cognitive development, Azevedo suggests that computer-assisted instruction can be provided by tutoring agents, the functions of which would be modelled after the interventions supplied by human tutors. The purpose of such interventions is to facilitate "qualitative shifts in students' mental models" (p. 203), which represent accommodation to new information and the adaptive restructuring of unsophisticated understandings. To study the role of scaffolding, Azevedo and his associates recorded think-aloud protocols provided by students who studied complex and challenging science topics (physiology and ecology) using hypermedia tools. The research team compiled a list of thirty-three SRL sub-processes (based on the five areas listed above), and qualitatively coded the discourses transcribed from the think-aloud activities as students worked the problems. In addition, pre- and post-tests measured declarative knowledge as well as the quality of the students' mental models of the processes being studied. Their independent variable was the type of scaffolding provided by human tutors: no scaffolding, fixed scaffolding (sub-goals related to academic content) and adaptive scaffolding (related both to content and to the processes of self-regulated learning). After a series of studies with students at different levels of education, it was reported that, "adaptive scaffolding by a human tutor who provides timely content and process-related scaffolding during learning tends to lead to significant qualitative mental model shifts for middle school, high school, and college students" (p. 204). Declarative knowledge gains were greater for college students who received either fixed or adaptive scaffolding, while younger students benefited from adaptive scaffolding (but not from the nonadaptive type). Think-aloud protocols indicated that students without scaffolding displayed the least self-regulatory behaviour; those in the fixed-scaffolding condition monitored their progress on the tasks, but those who were provided with adaptive scaffolding "engaged in an inordinate amount of help-seeking from the human tutor" (p. 204), and used self-regulatory strategies more than the other groups. Azevedo concluded, "In sum, the think-aloud data and discourse analyses tend to indicate that successful students regulate their learning by using significantly more metacognitive processes and strategies" (p. 205). Ultimately, Azevedo claims, "[I]t would make sense for a CBLE to emulate the regulatory behaviour of the human tutor … the system would ideally need to dynamically modify its scaffolding methods to foster the students' self-regulatory behavior during learning" (p. 205). He notes that the day has not yet arrived when electronic tutors can detect a learner's pedagogical needs with the same sensitivity as a human teacher, but (as we progress towards meeting this "technical challenge") we can develop computer-based tutoring systems that recommend goals and strategies which will facilitate the learning of self-regulatory processes, and thus support students in increasing their understandings of complex problems.

Computer-Mediated Communication

Salomon (1994) described group cognition as a phenomenon which emerges dynamically as a result of individual contributions to a common conversation, and which differs from the sum of its various parts. He acknowledged the importance of individual cognitive processes, which are instrumental in the progress of the group discourse, and he notes that individuals are affected by the contributions of others and by the patterns of results as they emerge. These *cognitive residues* of the collective effort represent lasting changes to individuals' ways of thinking. Salomon points out that intellectual partnerships support individual cognitive development, and he encourages *reciprocal scaffolding*, which calls for partners to work together on each problem (rather than patching together individual pieces of work). Computer-mediated communication provides a means for collaborative inquiry, and for the development of group knowledge.

Stahl (2006) claims that technological tools can support and facilitate group cognition, which expands the limits of cognition beyond what is possible for an individual. He stresses the need for understanding how collaborative processes operate, since such understandings aid us in designing software tools to facilitate collaborative learning, analyzing instances of collaboration, and developing theories which address how these processes function and evolve. In particular, we need to understand how to support the formation of collaborative learning groups, facilitate the accommodation of diverse interpretative perspectives, and support the negotiation of group knowledge.

Hewitt (2001, 2003) analyzed how university students interacted in asynchronous online discussions. Hewitt (2001) pointed out that, while the online environment provides flexible possibilities for deep discussion, students typically failed to use techniques of summarization and synthesis to draw together ideas that have been advanced in sequence; he observed much more branching than converging. Hewitt (2003) remarked that the phenomenon of attention being focused on the latest message in a discussion thread led the discussions off-topic. Hewitt (2001) made many recommendations, including: appointing a moderator to summarize the discussion (preferably a student, so that students could learn to develop a deeper understanding of the problem-solving processes and the ways in which ideas may interrelate); augmenting asynchronous computer-mediated communication with synchronous technologies (such as video conferencing) to make group coordination and negotiating group consensus easier; initiating "how to proceed" online discussions with students at the beginning of the unit before placing them into smaller workgroups in which they will continue to work throughout the semester, with designated and rotating roles (such as "starter," "moderator" and "wrapper"); and separating the substantive content from "meta-communication" of the knowledge-building process to avoid cluttering the work space with messages about due dates, etc., rather than concentrating on the problems and issues under discussion.

Lapadat (2000) stressed the need for advance organization of online discussions, pointing out that the rules for what is acceptable practice should be specified from the outset, and that students should receive technical support and guidance throughout the process. In addition, the topics for the discussions should be pre-established, and instructors who serve to focus the conversation on important issues should moderate the processes. Since many students have shown reluctance to participate, course grading should require participation in class discussions.

De Bruyn (2004) agreed that students generally display a low degree of incentive in the production of progressive online discourses, and designed instruction to support the process. She provided structured learning guides to aid in problem solving and inquiry-based learning, and found that students' familiarity with these strategies, and their facility with the online environment, seemed to affect their levels of participation. She recommended that instructors model the desired skills for the benefit of those students who are unfamiliar with the learning environment, that a moderator can help by summarizing the discussions, and that learning objectives be kept in view so that the discussions are clearly focused.

Geelan and Taylor (2001) stressed the importance of open, yet critical, discourse. They describe the conversational ideal as a process where each student participates hermeneutically in inquiries where they consider the phenomenological experiences of their interlocutors (as well as their own). They encouraged educators and students to understand each other through careful listening that appreciates the sub-text of each message, and to co-construct knowledge and meaning in the context of their respective experiences. The authors recommend that participation be graded through careful assessment of the qualities of individual participation, including the quality of students' assessments of the tutors' participation.

So and Pun (2004) reported on the development of an interactive web-based learning platform for student teachers that incorporates streaming video clips as instructional aids. Using Synchronized Multimedia Integration Language, their application allows for video cases (of teachers conducting classroom activities) to be recalled during an online conference, while a synchronous messaging window provides space for students to analyze the clips, and discuss key points. This type of application may certainly be of use in a great number of pedagogical contexts, and such tools may well aid the development of progressive and critical discourses.

Schrire (2004) conducted an exemplary study of higher-order cognitive development during asynchronous computer conferencing in advanced learners (doctoral students in educational technology). While the results from studying the work of doctoral students may not generalize to other learner populations, and while the discourse analysis methodology she applied may be somewhat difficult to use, her work in analyzing the cognition and interaction parameters in learning conversations is an excellent demonstration of the application of qualitative empirical research to the analysis of learning processes. Schrire examined three computer forums, their component message threads (topics), and each message, in a multilevel analysis of the discourse spaces created in a computer conference. She operationalized the dimensions of interaction (by mapping the relationships of messages to each other) and cognition (using Bloom's Taxonomy, Biggs' SOLO Taxonomy and the Practical Inquiry Model of Cognitive Presence). Higher-order thinking was characterized by evidence of *analysis, synthesis* and *evaluation* (from Bloom's Taxonomy), *relational* and *extended abstract* reasoning (from Biggs' SOLO scale), and by *integration* and *resolution* of problem dimensions (according to the Practical Inquiry Model). Schrire concluded "collaborative processes play an important role in knowledge-building" (p. 498). In particular, *synergistic* interactions, which occurred when each message in a thread related to most of the other messages on that topic, characterized the collaborative construction of group knowledge, in contrast with instructor-centred or student-centred interactions, in which relatively unconnected messages addressed the main idea under discussion. She also described an intermediate type of interaction (*developing synergism,* in between instructor-centred and synergistic types) and one *scattered* conversation thread (where messages hardly related to each other). While the study of the interactions and the cognitive development of small groups of elite students may not provide us with general conclusions applicable to all learners, the ongoing analysis of synergistic collaboration is an important area of research in higher-order thinking.

O'Neill (2004) has described some benefits of telementoring in the context of a knowledge society. Working with Bereiter and Scardamalia's Knowledge Forum team at the University of Toronto, he has developed the notion of *open mentoring,* the maintenance of a relationship between one mentor and several high school students in an open forum where all messages are available for view to all participants. In a context of collaborative knowledge building in a community of learners, O'Neill has extended the principle of one-to-one mentoring (originally adapted from face to face meetings to be used in telecommunicative support) to make mentoring a group activity. Trained mentors, whose job is to support the processes of collaborative inquiry into ill-structured and complex problems (associated with student projects), can thus serve as models for students, who can use the opportunity to learn how to support each other in working together.

O'Neill studied 112 science and biology students in grades 9 and 11 who participated in group telementoring. He reported that, not only were students receptive to the possibilities offered by group mentoring, but also the mentors "felt that they had learned more about teaching and themselves through telementoring" (p. 190). He also noted that students learned to appreciate the support that they could get from observing their peers' progress, and that the mentors spontaneously facilitated this last process by advising the students to learn from their classmates' exemplary work.

Taylor (2004) analysed the work of forty-four teachers who were learning to use Information and Communications Technology (ICT) in their classrooms. Taylor performed careful assessments during a year-long case study, and (while she admits that the results of her qualitative analyses are not suitable for generalization), she reports having observed a great deal of improvement in her students' understandings, and applications, of critical pedagogy in this context. She characterizes their discourses according to epistemological sophistication (in a typology reminiscent of the one provided by Kuhn, 2001), where Stage 1 is uncritical acceptance of assertions (about ICT), Stage 2 reflects problematization (characterized by reflection, questioning and acknowledgment of complexity), and Stage 3 thinking is evidenced by deeper reflection: conditional and complex thinking, critical engagement, theorizing and predicting. Taylor reported that, with practice in creating discourses about ICT and pedagogy, students learned to appreciate the subtle pedagogic distinctions and complexities, which reflect better and worse practices. The learning process was evaluated as comprising three processes: *personalization*, learning how theoretical and practical issues evidenced themselves in students' thinking and in their practices; increasing *pedagogical sensitivity*, distinguishing and dealing with the complexities in observable events which signalled effectiveness or problems; and *contingent thinking*, recognition of the situated nature of issues and problems, and dealing with the deeper relationships of various (personal, social and institutional) elements.

Taylor drew some important implications about teacher education from the results of her study. First, she pointed out that "planning for learning in the area of ICT needs to be informed by understanding of how student teachers learn as well as the desirable end-point for this learning" (p. 54). We need to understand how understanding develops before we can train teachers to facilitate the process. The teachers, by reflecting on theories of ICT even as they integrated the methods in their practices, gained pedagogical insight into how their students learned. In addition, while student teachers may begin to learn their trade before they graduate, teacher education should continue "into their first few years of teaching" (p. 54).

Related Research

Constantinou and Papadouris (2004) have provided an interesting example of the possibilities for using technology (in this case, digital video of preservice teachers who were learning physics) to study learning *in situ*. The idea of producing video recordings of cognitive development in its dynamic form (observable actions over time) is consistent with the notion that qualitative research in education should focus on producing detailed records of the processes (and the contexts) of learning in action (Denzin & Lincoln, 2005; Winn, 2002; Young, 2004). The authors examined how eight preservice elementary teachers learned to make sense of observational data, and how they learned to change their ideas about physical principles, by videotaping them as they carried out detailed and systematic observations of electric circuits, and worked together to build consensuses on how to interpret their results.

Constantinou and Papadouris described a sophisticated theoretical framework for learning in physics upon which they based their analyses, which stands as an example for those who are concerned with studying higher-order thinking and cognitive complexity in any discipline. The dimensions of the descriptive system are: the *experiences* upon which observations are based; the *concepts*, or representations, which structure and organize our discourses; *epistemological awareness*, the mental perspectives according to which conceptual frameworks are constructed; the *reasoning skills* which are used to evaluate ideas and observations on the basis of prior understandings; and (positive) *attitudes*, which determine motivation and engagement to the tasks at hand. To this list, I would add *metacognitive self-regulation* (which includes self-monitoring, self-evaluation and self-correction; Bandura, 1986; Facione, 1990), *explanatory skills* (Facione, 1990), and *interaction skills* (Ennis, 1987).

The physics lessons studied by Constantinou and Papadouris were hands-on, problem-based and inquiry-based. Students worked in groups of four and interacted with electrical components to build circuits; instructors guided them in developing theoretical models of the electrical processes by helping them to spot inconsistencies in their reasoning and to negotiate epistemological difficulties (without suggesting particular problem resolutions). Analysis of the resulting digital videos produced some interesting results; it was seen that students sometimes failed to consider empirical observations when formulating theoretical hypotheses, and some even failed to make the observations which were specified in the protocols. This epistemological difficulty demonstrated to the researchers that the principles of systematic scientific analysis escaped these students, who relied instead on a group leader to produce an (erroneous) intuitive explanation of the phenomenon under observation (the heat generated by a circuit). In addition to this difficulty, some students never appreciated the importance of consensus on the measurement of each observation, again demonstrating a failure to appreciate the importance of empirical data in forming conclusions. A third epistemological barrier to learning was the evident failure to appreciate the importance of rejecting one of two mutually contradictory models, which demonstrated a lack of appreciation for engagement in rigorous inquiry processes. As a result, a great deal of conceptual difficulty was encountered in producing cogent explanations of heat distribution in the circuit being studied.

While the results of this case study should only be generalized with great caution (given the small sample and short duration), it provides an instructive example of research on the use of technology to support and facilitate cognitive development. The type of evidence gathered here seems be useful for providing empirical evidence on how people learn (or fail to learn); the study uses sophisticated video technology to study higher-order learning, and this is a very useful tool for qualitative research.

Creating a software product is a complex task, and teaching software production represents an opportunity for embedded instruction in higher-order thinking. Liu (2003) studied the design, implementation and evaluation of instructional support for developing cognitive skills in elementary, middle school and high school students who were studying multimedia technology in a context of problem-based learning. Her research used a long-term, mixed-methods approach; her students learned the theory and practice of design and analysis, and engaged the design of multimedia products. Liu claimed "some encouraging results in enhancing cognitive skills development" (p. 37).

First, the four stages of product development (planning, design, production and implementation) were discussed with students, and each phase was undertaken as a collaborative effort between artists, designers, programmers and managers. Brainstorming was succeeded by design, production, evaluation and revision, and applications were produced in an authentic simulation of real-world systems analysis and design. Liu's techniques required students to collect enough information, and acquire sufficient skills (including reflection, organization and project management), to create useful educational products. In the process, the participants responded to questionnaires about their participation in each phase, and the products were evaluated according to their content (complexity and appropriateness), their structure, their screen design, use of media, and originality. Some students agreed to produce concept maps that reflected their thinking (before and after their learning experiences); some students, teachers and parents participated in interviews. Reported measures demonstrated significant gains in design skills, and fourth-grade students who collaborated in designing their projects seemed to demonstrate "better understanding of the importance of planning and collaboration" (p. 33) than those who worked in a teacher-centred design environment.

Jonassen, Strobel and Gottdenker (2005) described the benefits of model construction with regard to facilitating conceptual change, noting that building conceptual models (semantic, mathematical or dynamic) can facilitate the appreciation of multiple alternative representations of relationships between structures, processes and beliefs. Conceptual change (the reconstruction of personal mental frameworks, schemata and perspectives) can be made evident through the construction of increasingly sophisticated models. The process of building and examining theories of relationships (reifying our conceptual frameworks in language and imagery) allows for the testing of our ideas about dynamic processes, and for the rejection of incoherent assumptions and inferences. Comparing different models of a process allows for the examination of different interpretations of the relationships between conceptual (and real-world) structures; unworkable models can indicate the need for reconceptualization of a mental framework by demonstrating a dysfunction (an inconsistency between the model's action and its expected functionality). "When expected values do not result from the model, learners are faced with a cognitive conflict that they must resolve. Resolving that conflict is a rich example of the conceptual change process" (p. 26). Jonassen *et al.* pointed out that metacognitive self-regulatory processes are galvanized by the activities involved in building and testing models of dynamic cognitive structures.

Fishman, Marx, Blumenfeld, Krajcik, and Soloway (2004) explored the failure of K-12 schools to implement *cognitively oriented technologies* to foster learning and higher-order thinking, concluding that innovations have not been developed and tested in ways that support school reform. While problems of implementation have been addressed at the level of classroom (or several classrooms), technological innovation cannot be successful without integration into larger (systemic) contexts, including teacher education, pedagogy assessment and curricular reform. Without consideration of issues of usability, "the field lacks a bridge between … development of learning technologies and the broad-based systemic use of these innovations in schools … [T]his calls for an augmented research agenda designed to enhance the usability of technological innovations developed by the research community, with positive consequences for scalability and sustainability" (p. 45). Usability refers to ease of use by teachers and students, and is a primary requirement for technological tools; sustainability refers to the question of whether teachers are willing and able to use an innovation over the long term, and scalability describes whether or not a tool is suitable for widespread use. Fishman *et al.* argue that research must not only examine learners, teachers, and classes, but (if innovations are to be accepted), it must be expanded to use schools and school systems as units of analysis. Measures at the systemic level may include instructional vision, technical access and support, collaboration between teachers, leadership, support for teachers, ease of adoption, and reporting of technology use. "We need to define questions that explicitly address issues of sustainability and scalability, if we hope for innovations to enter into widespread use ..." (p.48).

Other Qualitative Analyses of The Pedagogy of Cognition

Paul, Elder and Bartell (1997) surveyed faculty at California universities and colleges, concluding, "… there is a serious problem in preparing teachers for critical thinking instruction in California's K-12 schools" (p. 103). These authors recommended that the following education policies be adopted:

1. Information that fosters awareness of, and commitment to, teaching for CT should be disseminated.
2. Professional development courses on preparing teaching faculty to teach CT should be provided as "appealing opportunities" (p. 89).
3. Strong accreditation standards for teacher preparation in CT should be established. Teacher preparation for CT instruction should be strengthened and reinforced by creating career-long credential expectations.
4. Teaching credential examinations should include knowledge and skills related to CT.

While this list of policies seems to go beyond current practices at most educational institutions, it appears to be a useful set of guidelines.

Manconi, Aulls and Shore (2008) interviewed six teachers (two each from elementary, secondary and university levels) who used inquiry instruction, and two adult educators who did not employ inquiry techniques, reporting, "The noninquiry teachers interpreted guidance differently from the inquiry teachers. Instead of questioning their students, [the former] considered guidance to mean helping their students by showing them how to do things or indicate to them the correct response" (p. 263). On the other hand, "Teachers who possessed a clear conception of an inquiry approach to teaching were able to transfer their knowledge and their expertise to their students, who could then better understand what is involved and intended in the inquiry process" (p. 267).

Ruiz and Fernando-Balboa (2005) reported that, although some physical education teacher educators claimed to practice critical pedagogy (CP), fewer than half of those interviewed expressed a clear understanding of the principles and purposes involved in CP. These authors noted, "This lack of understanding of CP might be an important factor contributing to its limited success in physical education teacher education" (p. 243).

Ball & Wells (2006) describe the evolution of pedagogical practices in public education, arguing that the "didactic lecture-style format of large introductory classes" (p. 188) can be replaced by more effective teaching strategies. These authors recommend a neo-Vygotskian social theory of education that focuses on the processes of learning (as well as the objects of study and student work projects), and they argue for co-operative (rather than hierarchical) learning structures. They emphasize the importance of metacognition, which they describe as a "strategic awareness or reflection" (Ball & Wells, 2006, p. 190) with regard to one's individual learning processes and the results of those processes. The course they described (*Introduction to Theories of Education* for undergraduate students in a California university) was designed to provide opportunities for practical activities and conscious reflection; weekly lectures were supplemented by small section meetings and by study groups of four to six students, who kept learning journals as an aid to reflection and inquiry. Debate was strongly encouraged, and final grades were based on portfolios of work products.

Ball & Wells point out that the course organization focused the responsibility for forming learning goals on the students, that the skills of goal-formation are extremely valuable, and that the process allowed for the creation of learning goals that were "personally and socially relevant" (2006, p. 194) to the students. They report that the participants found the course to be quite different from other introductory courses (as they were required to define problems and to create the purposes for their activities); the authors consider that the metacognitive work involved in these processes enable "a deeper and more connected kind of sense-making" (Ball & Wells, 2006, p. 195), and they were pleased with the results, which demonstrated to them that the students engaged in "thoughtful and productive collaborative work" (p. 197).

Ball & Wells' emphasis on "sensemaking" through argumentation, and on metacognitive awareness, exemplify the pedagogical commitments that support and facilitate higher-order cognitive development.

> …[S]ensemaking … is initiated when people become aware of more and more varied cues, conceive of multiple meanings and seek to find some way to integrate or organize them … [T]hose students who were able to move beyond previously established expectations about their role and what would count as legitimate evidence or successful learning were able to find relevance and to integrate multiple meanings by adopting a

> dialogic and metacognitive stance toward their own learning, and thus come to a more complex understanding of how people learn generally. (Ball & Wells, 2006, p. 199)

Inferences

There is a large corpus of coherent descriptions of human cognition; we can understand a great deal about thinking. This is fortunate, because we need to understand thinking if we are to enable metacognition (cognitive self-monitoring and self-correction), which is an essential focus of the pedagogy of higher-order thinking.

The research described above represents a small percentage of the work produced by a large and vital research community, the members of which are dedicated to improving the quality of educational processes. This evidence of commitment, by a large number of researchers and practitioners, to the benefit of future students is heartening; even if the quality of the educational practices described above is far superior to that delivered in most schools, we are informed that (at least) *some* students are receiving high-quality cognitive and metacognitive support from informed and capable educators. We may hope that, as a result of a great deal of excellent work performed by these dedicated researchers and practitioners (and many others like them), the cogent theoretical views that they have brought to the field, and their most effective methods, will become widespread before very long.

Above all, it is important for educators to keep in mind the cautionary advice presented by Dickey (2005): *technological tools do not produce educational benefits*; rather, tools may be administered appropriately, with optimal timing, and their use may be closely monitored and managed by well-educated educators. Technology is no educational panacea; educators must learn to support students in managing their own learning, and the learning required to administer the use of technological aids (with optimal effectiveness) places a burden on teachers, teacher educators, and school administrators, according to the use of each application.

Higher cognitive development is apparently facilitated through the creation of progressive social discourses. While the evidence demonstrates that it is possible to produce successful results by teaching students to think critically, and while we can glean some hints about how to succeed in such efforts from the most successful interventions published, the quantity of high-quality empirical studies has not been sufficient to demonstrate exactly how to teach higher-order cognitive skills. The complexity of the subject, the variety of instructional methods, and the multiplicity of assessment instruments have produced a research environment that generates a lot of statistical noise, and no clearly consensual sets of guidelines. Until educators understand how best to teach complex and higher-order ideation, prospective teachers in teacher education programs cannot effectively be instructed in the means to facilitate their students' higher-order cognitive development.

To be more helpful in this area, researchers must not only execute well-designed empirical studies, but they also must describe the conditions of their studies as fully as possible. Without clear and complete descriptions of any non-standard assessment instruments used, and without explicit detail about the participants, the settings, the methods, and other features of the contexts of research studies, systematic reviews of literature cannot produce clear inferences about when, how and why CT instruction is more (or less) effective.

To support researchers in being effective, granting agencies should specify not only which subjects need to be investigated, but (more specifically) which independent and dependent variables are most important to the field, which populations most need to be studied, and which settings are likely to yield the most useful results. While the notion of academic freedom implies to many that researchers can arrange their projects as they like, the quantity of poorly designed and badly reported publications indicates that an increase in regulation of the quality, and the relevance, of research proposals which receive funding is required if the quality of evidence produced is to be increased. To produce clear evidence to practitioners and policy makers (as well as each other), educational researchers must operate within consensual frameworks with regard to which research is most needed and how it should be performed.

Apparently, few qualitative studies are available that describe the perspectives of teachers and students with regard to the development of higher-order cognitive/conceptual frameworks. While quantitative research has clearly demonstrated that many cognitive skill instructional interventions have been successful, it should be noted that qualitative research methods are also suitable (and perhaps more suitable) for describing, interpreting and evaluating the processes involved in learning and teaching about complex cognition and problem solving. The complex psychodynamics involved in instruction cannot be described in terms of third-party observations; *how* learning occurs is best described by learners themselves, and the ways in which teachers are inspired to ask students questions that prompt breakthroughs in their inquiries cannot be learned from summative assessments (but only from probing the participants' experiences of the processes involved). Programs of research in higher-order thinking should not ignore the value of qualitative research into the individual experiences which underlie, and which drive, the processes of teaching and learning.

In considering the experiences of those who engage in teaching and learning situations designed to promote and facilitate deep thinking, it is essential to consider the motivations, the attitudes and the dispositions of the participants. As Facione (1990) and his Delphi panel of forty-two expert educators pointed out, "To the experts, a good critical thinker, the paradigm case, is habitually disposed to engage in, and to encourage others to engage in, critical judgment ... Although perhaps not always uppermost in mind, the rational justification for cultivating those affective dispositions which characterize the paradigm critical thinker are soundly grounded in CT's personal and civic value ... CT promotes rational autonomy, intellectual freedom and the objective, reasoned and evidence based investigation of a very wide range of personal and social issues and concerns" (pp. 12-13). Yet, the dispositional component of higher-order thinking is not well studied; of one-hundred seventeen studies analyzed by Abrami *et al.*, only eight measured changes in CT dispositions. It seems that the importance of deep motivation (as described by Biggs, 1985) has not been emphasized by many researchers in this field, who seem to have ignored the idea that the intent to apply CT is at least as important as one's skill set. Until educators understand the importance of promoting their students' commitments to think critically, to analyze deeply, and understand the differences between well and poorly justified conclusions, all the knowledge that we gain about how to teach CT will be irrelevant to students and teachers who manifest little commitment to the development of higher-order conceptual frameworks.

Motivation and Affective Dispositions

Motivation is a hypothetical construct, an intervening variable that represents any theoretical force that stimulates or inhibits behaviour. *Extrinsic* motivation refers to environmental factors, forces that are not generated by organisms; *intrinsic* motivation refers to the cognitive and affective (organismic) processes that contribute to the likelihood that behaviours are manifested. Extrinsic motivation is of special interest in the psychological framework of *behaviourism*, in which relations between behaviour and environments are the main focus of study; however cognitive psychologists attend to motivation of the intrinsic sort (including desires, dispositions, attitudes and commitments to act in particular ways).

Biggs (1985) referred to three levels of (intrinsic) motivation (and three types of learning respectively associated with each level) that relate to the pedagogy of cognitive development. *Surface* motivation is the lowest level of interest in a subject; it is characterized by rote strategies (remembering and repeating information). *Deep* motivation refers to an interest in gaining competence with a subject, and it includes integrating and synthesizing material from different sources to create coherent sets of understandings; *achievement* motivation represents the commitment to excel in cognitive work, to learn things as well as they can be understood. Clearly, surface learning is an inferior method for facilitating cognitive development, and students who intend to work hard and learn deeply are more likely to achieve broader and more coherent understandings of their subjects (Boekaerts, 1995). Pressley (1995) maintains that social support systems are essential in supporting students' motivation to implement self-regulated learning practices.

Intrinsic motivation is a hyper-complex construct described in the educational literature as a set of sub-constructs that include self-efficacy, mastery beliefs, self-regulation, goal-setting, attributions, needs, emotions and achievement strivings (O'Donnel, D'Amico, Schmid, Reeve and Smith, 2008). Motives are manifest in attitudes (or dispositions), which represent tendencies to behave in particular ways. The nineteen "critical dispositions" described by Facione (1990), provide a motivational framework that is well suited for initiating and maintaining the deep learning that leads to higher cognitive development; the author makes this point in describing the "ideal" critical thinker.

> The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fairminded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider … diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical thinkers means working toward this ideal. (Facione, 1990, p. 3; emphasis added)

In addition, critical thinkers are "understanding of the opinions of other people" (Facione, 1990, p. 25).

Siegel (1991) proposes a similar view of the notion "critical spirit," writing,

> There is yet a further component of critical thinking – the 'critical spirit'- which has been by and large ignored in recent discussion of the generalizability of critical thinking …The 'critical spirit', as I am using the

term, refers to a complex of dispositions, attitudes, habits of mind, and character traits. It includes dispositions, for example the dispositions to seek reasons and evidence in making judgments and to evaluate such reasons carefully in accordance with relevant principles of reason assessment; attitudes, including a respect for the importance of reasoned judgment and for truth, and a rejection of partiality, arbitrariness, special pleading, wishful thinking, and other obstacles to the proper exercise of reason assessment and reasoned judgment; habits of mind consonant with these dispositions and attitudes, such as habits of reason-seeking and evaluating, of engaging in due consideration of principles of reason assessment, of subjecting proffered reasons to critical scrutiny, and of engaging in the fair-minded and non-self-interested consideration of such reasons; and character traits consonant with all of this. People who possess the critical spirit *value* good reasoning, and are disposed to believe, judge and act on its basis. It is this genuine valuing, and the dispositions, attitudes, habits of mind, and character traits which go with it, which constitute the core of the critical spirit. (Siegel, 1991, p. 26, original emphasis)

Paul and Elder (2002) have described nine dispositional “intellectual” characteristics which they consider as indispensable to the critical thinking (CT) process: integrity, humility, sense of justice, perseverance, fair-mindedness, confidence in reason, courage, empathy and autonomy. These authors note that the consideration of intellectual standards (including logic, and accuracy of reporting) is essential for fair-minded thinking. They emphasize freedom from bias and prejudice, perseverance, humility (the acknowledgment of fallibility), honesty and autonomy; these dispositions allow for the development of reasonable discourses. Yet, "these traits … are rarely taught … [B]ecause they are largely unrecognized, these traits are not commonly valued. Yet each of them is essential to fair-mindedness and the development of critical thinking" (Paul and Elder, 2002, p. 21).

Paul and Elder have done an excellent job of describing CT in relation to discursive practices. They elaborate upon the purposes involved in CT (including the achievement of clarity, significance, consistency and justifiability), and they stress the possibility of the reconciliation of various points of view (which requires flexibility and breadth of vision). In addition to the requirement for confirmation of the accuracy of information used in inquiry, they describe the need for the clarification of the concepts and the assumptions (as well as the implications) used by any line of thought, and they acknowledge the importance of validation of inferences and interpretations, which follow from a line of reasoning.

Paul and Elder also explain how critical thinking applies to decision-making. Effective and rational decision-makers are aware of (and are able to re-evaluate) their "most fundamental goals, purposes, and needs" (Paul and Elder, 2002, p. 149); they describe situations and alternative courses of action as precisely as they can, and they consider the consequences and the implications of each alternative. They actively seek relevant information, which they analyze and interpret carefully, evaluating each option in the light of circumstances, and adopting an appropriate strategy, which considers all of the above. Finally, competent decision-makers monitor and evaluate the consequences of their actions, and are ready to modify their analyses and change their strategies as more information becomes available.

In consideration of the above perspectives, the individual commitment to inquiry may be seen as an essential disposition for higher-order cognitive development. Aulls and Shore (2008) claim, "Promoting a more inquiring public, and especially teachers who are capable of using inquiry to develop as a professional and to build the independence of students as learners, should be a central goal of education … Making inquiry an imperative in our formal curriculum at every level has not yet been systematically done, but we see no reason that it cannot be accomplished by a significant proportion of the teachers whom our children encounter" (p. 290).

Ennis (1987, 1998) added another interpersonal dimension to our lists of critical dispositions; he acknowledged the importance of caring for people other than oneself, including taking into account others' feelings and being concerned about their welfare. This is an ethical dimension, which relates morality to critical thinking; although we may consider higher-order thinking as an individual project, which is sometimes practiced in isolation from others, descriptions and assessments of thinking are social phenomena, and they should be considered in terms of social relations. Relationships, communities and societies depend on ideas and actions that are acceptable to more than one individual; therefore one of the motives that enable perspicuous thinking is the consideration of the needs and the interests of (more or less diverse) others. Thus we need not only to listen to other people, but also to consider their ideas, their discourses and their habits of behaviours in accordance with contexts that supersede our individual interests. This type of broad and open-minded consideration of social factors is essential, not only in learning to expand one's thinking beyond narrow personal/historical frames of reference, but especially in supporting others in doing so.

Noddings (1984) wrote that those who care for others should manifest the specific intention to acculturate others into an ethos of caring, in order "to preserve and enhance caring" (p. 172) in oneself and others. "This quite naturally becomes the first aim of parenting and education" (p. 172), an aim that should never be superseded by rationality, which, "while important and prized, must serve something higher … The primary aim of every educational institution and of every educational effort must be the maintenance and enhancement of caring" (p. 172). This ethical perspective on education should be of interest to every educator; thinking is instrumental to our values, our intentions and our goals, and education should be designed to serve the creation and maintenance of beneficent goals and purposes, manifestations of our commitments to provide benefits to others as well as to ourselves.

Attitude Learning

Gagné & Driscoll (1988) have provided a highly insightful, and very useful, dynamic model for the instructional techniques and conditions that facilitate the development of an attitude, which they define as "a learned capability that affects the learner's choice of personal action … an internal state that originates processes of *executive control*" (p. 97, original emphasis). This definition describes our tendencies and dispositions, constructs which represent the behavioural manifestations of our intentions and motives. On the question of how to teach students to develop new attitudes, their description comprises three dimensions of learning and teaching. First, learners must come to realize that an attitude (which they do not habitually manifest) would be of value to them. “The establishment of an expectancy [of success] is a particularly critical feature in the learning of an attitude” (Gagné & Driscoll, 1988, p. 98). To learn this, one may observe a role model, with whom they identify, perform an action that is representative of a particular attitude, and experience a successful outcome; or they may be reminded of a time when they performed such an action (contrary to their old habits) and were rewarded. They must also be provided with opportunities themselves to perform actions that are consistent with the new attitude, and “the expectancy that is activated must be confirmed” (Gagné & Driscoll, 1988, p. 99). That is, the learners must be rewarded for their actions, or they must observe a successful outcome for the role model. These authors have suggested that new attitudes, which are more adaptive, and more facilitative of learning outcomes, may be developed if the appropriate techniques and conditions are implemented in our instructional environments. This implies that these techniques can be applied to support our students in developing the affective dispositions that lead to higher-order cognitive development.

Inferences Regarding Higher Cognitive Development

I infer that deep (or achievement) motivation is required for advanced cognitive development, and that the motivation to learn is manifested through a variety of attitudes (dispositions or commitments to intellectual work). Attitude development can be facilitated through educational processes; however, not all students do the work, or manifest the commitments, that enable the development of higher-order, complex, and coherent sets of ideas.

Self-Regulation and Learning

Metacognition and Metalearning

Flavell (1979) described *metacognition* as higher-order thinking processes which actively control knowing and learning. Biggs (1985) used the term *metalearning* to describe awareness and control of one's learning; for each of us, metalearning requires knowledge of how we learn, motivation to monitor and regulate our learning, and the capacity to regulate our actions with regard to learning and cognitive development. Academic and practical understandings of these two hypothetical constructs are useful in developing methods to facilitate instruction in the recognition, definition, and resolution of complex and ill-defined (academic or practical) problems.

Self-Regulated Learning

Pintrich and Zusho (2002) reviewed theories of self-regulated learning (SRL), pointing out that four areas of human functioning are subject to self-regulative control during learning: cognition, affect (and motivation), behaviour, and learning contexts. These authors describe self-regulation as being driven by a complex of knowledge and skills that take time to learn (so older students are more capable in this area than younger ones). SRL develops through a positive feedback cycle: more learning leads to more self-regulation, which leads to more learning. Schunk (1989) agrees that students contribute actively to their learning goals and exercise a large degree of control over their attainment, writing, "People are motivated to learn behaviors that they value and that they believe will lead to rewarding consequences" (p. 85). Corno (1986) specifies various forms of control that can be developed; *attention control* (which describes the value of attending to task-relevant information and resisting distractions); *motivation control* (or "state orientation," including self-reinforcement and penance), *emotion control* and *environmental control* (e.g. asking for help).

Paris and Paris (2001) reviewed classroom research on self-regulated learning, describing the relevance of a variety of factors, and presenting some interesting conclusions with regard to effective educational practices. They noted that observable actions could indicate the operations of three different sets of factors, including (a) cognitive engagement (interest in the task, determined by the type of task and the student's personal interests), (b) self-assessment (which has profound effects on motivation to continue working on a problem, or to take interest in similar problems in the future), and (c) the use of strategies in reading and writing. In particular they stressed the importance of learning how, and when, to use strategies, and to attribute success or failure respectively to proper or improper strategy use (rather than to luck or to personal inability to learn). They noted that peer support, planning, and practice are important elements of success in learning to self-regulate, and learning to internalize standards of effort and performance. Paris and Winograd (2001) have emphasized the need for teachers to learn self-regulative skills, so that they might model self-regulated learning (SRL) during instruction. "[T]eachers must be reflective and analytical about their own beliefs and practices and they must acquire a deep understanding of cognitive and motivational principles of teaching" (Paris & Winograd, 2001, p. 1). Teachers can be taught to analyze their own learning styles, and to evaluate their own understandings, in order to manage their own learning. Students, including pre-service teachers, can learn to recognize when they are thinking well (clearly and coherently), in contrast to thinking poorly (making errors in analysis or justification). Schunk (1989) posits that effort-attributional feedback also promotes self-efficacy, and "The belief that one is capable of learning is an important part of the self-regulation process" (p. 106).

The idea of SRL is closely tied to the theory of learner-centred instruction. As Zimmerman and Schunk (1989) have remarked, "As an organizing concept, SRL describes how learners cognitively, motivationally and behaviourally promote their own academic achievement" (p. ix). Zimmerman (1989) noted, "[F]or learning to occur, students must become proactively engaged at both a covert as well as an overt level" (p. 22). Zimmerman (1990) notes that "self-regulated students" consistently use metacognitive, motivational and behavioural strategies, and are especially responsive to feedback; he emphasizes that self-regulation involves the planning, goal-setting, organizing, self-monitoring, and self-evaluating mechanisms that are part of the individual's approach to learning.

Winne (1995a) describes SRL as self-regulative cognitive engagement, which requires a deliberate, judgmental and adaptive attitude towards self-development. Processes include seeking and retrieving information, monitoring engagement, tuning strategic plans, and revising knowledge of oneself (as well as knowledge of the domain being studied). Four basic ingredients are required for teaching students to self-regulate: content knowledge of the domain; conditional knowledge of which cognitive strategies are applicable in various learning situations; action knowledge (cognitive, metacognitive and behavioural skills involved in learning); and motivation to learn effectively. Winne (1995b) notes that SRL is expanded through social processes, and that novices might (mistakenly) focus on objectives, and assessment criteria, that are relevant to them (rather than those that their instructors prescribe). Winne also suggests that the nature of mental effort is not well understood, and that research should focus on such problems as determining: how goals are formed and how they guide SRL, how understanding is proceduralized in tacit forms, and how individual differences in cognition can be accommodated through instructional methods.

Winne (2005) points out that learners are agents who construct knowledge, therefore they always self-regulate their own learning. However, effective SRL is not automatic; effective instructional scaffolding can enable students to "bring SRL into mindful focus" (Winne, 2005, p. 562); to recognize when SRL is needed; to be informed (through process feedback) about the qualities of their results; and to keep track of what they learned and how they learned it.

Measuring Self-Regulatory Processes

Measures of metacognitive self-regulation have received some attention in recent history from researchers in psychology and education. Most of the metacognitive self-regulation measures that are reported in academic journals ask respondents to rate their use of behaviours that are designed to regulate cognitive functions (e. g., study habits and problem solving methods).

Schraw and Dennison (1994) constructed a 52 item self-ratings inventory to assess adults' metacognitive awareness (the Metacognitive Awareness Inventory, or MAI), pointing out, "metacognitive awareness allows individuals to plan, sequence and monitor their learning in a way that directly improves performance" (p. 460). They used a one hundred millimetre rating scale (from never to always) to indicate self-rated levels of identification with inventory items based on eight theoretical dimensions: metacognition, declarative knowledge of cognition, procedural knowledge, conditional knowledge, use of information management strategies, monitoring, debugging strategies and evaluation. Factor analysis of the scores (using both varimax and oblique rotation) revealed six factors, which did not correspond closely with the eight theoretical dimensions, and the researchers opted for a forced two-factor solution: knowledge of cognition (what students know about themselves, strategies, and the conditions under which strategies are most useful), and regulation of cognition (knowledge about the ways that students plan, implement strategies, monitor, correct comprehension errors and evaluate their learning). Sperling, Howard, Miller and Murphy (2002) developed and tested the Jr. MAI for students in grades three through eight; similar results were reported.

A group at Western Illinois University (Gordon, Lindner, & Harris, 1996; Harris, Lindner, & Gordon, 1996) developed the Self-Regulated Learning Inventory (SRLI) for university undergraduates, in order:

> … to help researchers and teachers better understand the construct of self-regulation as it relates to academic success, … to provide a tool for use in identifying behaviours, skills and attitudes students need to help achieve academic success, and …. *to provide diagnostic insight into the needs or learning problems of particular individuals.* (Gordon *et al.*, 1996, p. 2; emphasis added)

The SRLI measured five cognitive skill dimensions: metacognition, learning strategies, motivation, contextual sensitivity and environmental utilization and control; the instrument asks respondents to rate (on a five-point scale from "not at all typical of me" to "almost always typical of me") their identification with effective study habits, motivating and de-motivating factors, help-seeking, and reflective practices. According to these researchers, "we ... arrived at the working conclusion that metacognition, although mediated by, and dependent upon, the other components we had so far identified, represents the key to self-regulation of the learning process" (Gordon *et al.*, p. 4).

Researchers at the NASA Classroom of the Future at Wheeling Jesuit University (Howard, McGee, Hong, and Shia, 2000) categorized self-regulation skills applied by science students in a computer-based learning environment. Their self-rating test items asked respondents to rate (on a five point scale from never to always) their use of particular problem solving skills, reflective strategies and self-efficacy. Their test instrument (the Inventory of Metacognitive Self-Regulation, or IMSR), examined five metacognitive skill dimensions: Knowledge of Cognition (the understanding of one's cognitive processes), Objectivity, Problem Representation, Subtask Monitoring and Evaluation. Regression analysis showed that total score on the IMSR significantly predicted Content Understanding and Problem Solving. Three of the five factors (Knowledge of Cognition, Problem Representation and Objectivity) were significant predictors of Content Understanding; these three skill dimensions, and Evaluation, predicted Problem Solving at significant levels.

Sperling, Howard, Staley and DuBois (2004), studied undergraduate students' metacognition (as measured by the MAI), motivation (using the Motivated Strategies for Learning Questionnaire, developed by Garcia and Pintrich, 1995), study strategies (using the Learning Strategies Survey, developed by Kardash and Amlund, 1991) and achievement (Scholastic Aptitude Test, courses dropped, and high school Grade Point Average). They found that metacognition scores correlated inversely with courses dropped (which was expected), but also correlated inversely with math scores (a surprising result). No correlation was found between the MAI scores and high school grades, but study strategy use and metacognition scores were significantly related ($r = .60, p < .001$). The correlation between the motivation and metacognition measures was moderate, but statistically significant ($r = .40, p < .05$).

Inferences Regarding Cognitive Development

According to Paris and Paris (2001), "teachers can provide information and opportunities to students of all ages that will help them become strategic, motivated and independent learners" (p. 89). Zimmerman (2008) claims that SRL "enable[s] learners to transform their mental abilities … into academic performance skill" (p. 166). It appears that learners can develop metacognitive and meta-affective processes, which can be targeted and assessed by instructors. SRL requires foresight, monitoring, control and reflection; and deep motivation is required to integrate skills and attitudes to develop deep comprehension of any subject matter.

Dynamic Complexity

Complex Dynamic Systems

Ni and Branch (2008) describe complexity as "a common phenomenon existing in biological organisms, geological formations and social constructions … however, complexity as a factor in educational technology tends to be maligned, oversimplified, or otherwise insufficiently addressed …" (p. 29). Érdi (2008) describes the evolution of the idea of "complex systems" as distinct from simple systems; the latter are described in terms of one cause and one effect, with small changes to the cause resulting in small changes to the effect in a predictable manner. On the other hand, complex systems contain circular causality, logical paradoxes and strange loops, where small changes to causes may produce dramatic effects, and results are unpredictable (emergent). Dynamic (or dynamical) complexity refers to temporal processes; where "irreversibility and periodicity are recurring themes" (Érdi, 2008, p. 3). While complexity theory has been applied in many subject areas, human cognition is one fruitful area of inquiry. "The notion of cognitive complexity … has been used as a basis of discussion on the complexity of personal constructions of the real world … The complexity of the world view of a subject can be measured … [for example] a subject with the ability to see people as a mixture of 'good' and 'bad' characteristics has a higher 'cognitive complexity' [than one who sees friends as good people and enemies as bad ones]." (p. 4).

To Sterman (2001), "Systems dynamics is fundamentally interdisciplinary …We take actions that make sense from our short-term and parochial perspectives, but due to our imperfect appreciation of complexity, these decisions often return to hurt us in the long run" (p. 10). An understanding of "systems thinking" is especially important when inquiring into cause and effect relationships in complex situations.

> The heuristics we use to judge causal relationships systematically lead to cognitive maps that ignore feedbacks, nonlinearities, time delays, and other elements of dynamic complexity. To judge causality, we use cues such as temporal and spatial proximity of cause and effect, temporal precedence of causes, covariation, and similarity of cause and effect. In complex systems, however, cause and effect are often distant in time and space, and the delayed and distant consequences of our actions are

> different from and less salient than their proximate effects—or are simply unknown. The interconnectedness of complex systems causes many variables to be correlated with one another, confounding the task of judging cause. Research shows that few mental models incorporate any feedback loops. For example., studies have found virtually no feedback loops in the cognitive maps of political leaders; rather, the leaders focused on particular decisions they might make and their likely consequences—an event-level representation. Experiments in causal attribution show people tend to assume each event has a single cause and often cease their search for explanations when the first sufficient cause is found. (Sterman, 2001, p. 16)

Dynamic systems theories make use of mathematical functions, which describe the relationships of successive *system-states* of mathematical spaces, which comprise any number of points in any number of mathematical dimensions. Each point in a system space, at each point in time, is characterized by a binary value (0 or 1), and the values of all points at one moment in time define the state of the system (the system-state). The mathematics that define the relations of one system-state to the next (and the next, and the next) increase in complexity with the number of dimensions in the system and with the length of time under consideration. This abstract general model has proven itself to be extremely useful in many fields of study (the math is derived from the equations of thermodynamics, which cover a three-dimensional spatial system and are very useful in physics); new forms of computer architecture (*neural net* technology and *connectionist* machines) have been derived from this idea, and educational psychologists have applied such notions as feedback loops and reciprocal causation to the description of learning processes. Biologists have applied the notion of *self-organizing systems* to maturation and development

Since cognitive functions (and the neurophysiological systems upon which cognition is generally believed to depend) are highly complex, and since teaching/learning systems are even more complex (involving the interactions of human beings with each other and with educational materials), it is useful to understand how dynamic processes (such as reciprocal causation) may be applied in pedagogical terms. The ideas of *ecological psychology* (Young, 2004) have been developed in accordance with the principles of dynamic systems, and provide cogent insights into the interdependent functions of thinking/acting systems.

Lewis (2005) also pointed to the potential utility of the dynamic systems (DS) perspective in psychology.

> Nonlinear dynamic systems operate through reciprocal, recursive, and multiple causal processes, offering a language of causality consistent with the flow of activation among neural components. Consequently, psychological accounts informed by DS ideas may be more biologically plausible and better able to integrate neural findings ... DS ideas may provide a foundation for building models that incorporate the rich psychological categories of emotion theory with the biological realism of neuroscience, by addressing causal relations and part–whole relations in a manner relevant for both. (Lewis, 2005, p. 169)

Nonlinearity is the property of mathematical functions that entails discontinuous (rather than incremental) changes in system-states; because information in dynamic systems is carried through variations in complex multidimensional patterns of activity (as opposed to stepwise linear increments), it is possible that the stable patterns (*equlibrium* states) of a system at one point in time may change drastically in relation to the stable patterns that had characterized the system previously. For example., the initiation of a nuclear chain reaction, or the introduction of a catalyst in a chemical reaction, produce irreversible changes in the functions of sub-atomic systems.

The development of connectionism as a theory of cognitive processing may well have invalidated the assertion that the "container theory" of mind as a repository of mental objects, with its attendant representational baggage, is "the only game in town" (Fodor, 1985, p. 90). Rather than using symbolic representations of objects as mental units, connectionism uses binary nodes, arranged in hierarchical networks, to transform information (from 'inputs' to 'outputs'). This process, modelled on a simplified view of biological nervous systems (and sometimes called "neural net" machine architecture), is accomplished through the assignment of (excitatory or inhibitory) "weights" which are associated with the connections between the nodes. Such machines have been trained (through the adjustment of these weights) to perform pattern recognition tasks, an accomplishment which is relatively impracticable through the processing of symbolic representations. The operation of connectionist machines has demonstrated that information processing can proceed without semantically transparent symbols. Connectionism provides insight into understanding how cognitive appraisals can emerge without any necessity for direct correspondences between material objects and mental ideas; physical processes and mental functions are related only indirectly. Connectionist machines also illustrates the notion of functional dynamics, which incorporates the understanding that relations between conceptual objects (which determine the outcomes of cognitive functions) are continually subject to change with time; as connection weights are adjusted, the relations between inputs and outs vary commensurately.

Connectionism provides a new operational theory of cognitive (mental) structures, one which is susceptible to analysis in mathematical terms (since the connection weights are quantified). Furthermore, connectionist machines (aside from their genesis as simplified models of nervous system structures and functions) display features which demonstrate a resemblance to human functionality; since the relations between inputs and outputs involve the operation of all elements in the network ("parallel distributed processing"), damage to parts of the system result in performance deficits rather than in complete failure of the system to perform its task. This phenomenon ("graceful degradation") may be seen as evidence for the superiority of connectionism as a theory of mind, as (in contrast) the sequential processing of symbolic representations is halted (or severely compromised) if any step in the process is prevented.

The connectionist theory of mind serves to illustrate the applicability of general systems theory to mental function. The binary nodes in a connectionist network are analogous to arrays of points in theoretical system-space (each of which, in theory, is assigned a binary value). The transformation of such a system from moment to moment in time may be described mathematically in terms of functional dynamics; thermodynamics exemplifies the application of dynamic functions to the behaviour of physical materials, and it is possible that mental functionality, and linguistic discourses, may be amenable to description in terms of complex dynamic functions (Franklin, 1995; Globus, 1995; Clark, 2001). The new theory of mind would require no direct correspondence between mental and concrete objects, a situation that is quite consistent with neo-pragmatic philosophy (which obviates the necessity for beliefs to correspond with a purely objective reality; Rorty, 1991). Another way to grasp this idea is to understand that a single pattern of variation in data conveys different information to different interpreters, each of whom provides the context for her own interpretation.

In a nonrepresentational cognitive system, clear (that is, rational and perspicuous) thinking is characterized by coherency (logical consistency) amongst syntactic and semantic functions (language usage); this in contrast to foundational systems of knowledge, which require a basis of epistemic truth. The value of this new way of thinking about understanding lies in its deliverance from a dependency on the foundational ideas of ancient and modern philosophy. Our understanding of wisdom (in the contemporary scheme) is transformed; rather than comprising knowledge of how things really are, the construct of wisdom relates to a consistency in the (dynamic) maintenance of relationships between objects (both abstract and concrete). Coherent conceptual schemata are those which are justified by the most reliable of available evidence, and which are assembled in accordance with consensual rules of logic and mathematics (formal languages) as well as those of natural language semantics.

Bereiter and Scardamalia (1996) point out that learning objectives vary in their levels of abstractness (on a continuum from fully situated in a context to fully abstract), and that deep (intentional) learning requires high levels of abstract thought. Bereiter (1997) explains that models of artificial intelligence that are based on rule-based information processing (the manipulation of symbolic representations of things and events) provides a poor way of describing learning, failing to explain basic cognitive processes such as pattern recognition or transfer of learning; however DS approaches to cognition can manage pattern recognition, and allow us to abstract relations between variables. Bereiter and Scardamalia (1998) note that "folk psychology" (the "container" metaphor of mind) does not support the best teaching practices; appreciation of literature, number sense, mental maps, and creativity cannot be appreciated through ideas of linear, step-by-step cognitive processing.

According to Bereiter and Scardamalia, teachers must distinguish ways of conceptualizing knowledge and its uses; no single approach will handle all situations. Understanding the nature of deep, coherent knowledge requires a connectionist (non-representational) understanding of mind and recognition of knowledge objects as abstract artefacts. Deep understanding means understanding deep (domain-related) things about a subject; rather than recollecting ideas and relationships, deep understanding implies abilities to interact intelligently with people and objects, to explain and solve problems, and to be aware of the limits of one's understandings. Of course, language rules are subject to change (especially those of natural languages, where new words and meanings are continually being invented), and new evidence (confirming or disconfirming existing schemata) arises all the time.

Practical wisdom thus requires constant vigilance with regard to the dynamic maintenance of consistent relationships within our conceptual frames. Condon (2008) provides a cogent description of the pedagogical complexity faced by educators who intend to participate in learning and teaching for the development of complex cognitive schemata, since,

> To learn and to teach the complex processes by which knowledge workers in multiple disciplines define, abstract and situate, and analyze or propose solutions to problems requires that we consider how we learn and teach both the intellectual and affective dimensions of thought, practice, and articulation. These dimensions cannot be apprehended through a resort to prescriptions for practice. They are less akin to skills than to (re)frames through which we see, which bound our sense, our imaginations, our making of meaning, and our ability to articulate productively. Rather than conceiving of the range of conditions that might constitute needs for students and faculty as an itemized list, I am inclined to see those conditions as separate but related constellations of ways of thinking, learning, making sense and meaning; ways of naming, framing, and reframing problems; and ways of recognizing, honoring, and expressing mutual contingency. Imagining overlapping, evolving, expanding, and contracting zones in and through which these constellations swing seems useful to capture and begin to consider responsible institutional and pedagogical practice. (Condon, 2008, pp. 91-92)

Wide Dynamic Reflective Equilibrium

The dynamic systems theory of cognition postulates that minds transform uncountable bits of information through many conceptual dimensions, and that cognition does not rely on computation or information processing, instead resulting from the emergence, and the extinction, of highly complex patterns of functions. This view of cognition supersedes the paradigm of 'information processing,' and this model may provide inquiring learners with a new and deeper understanding of learning and its associated psychological (affective as well as cognitive) processes.

In particular, the dynamic systems approach to analyzing thinking allows for unique perspectives on the notions of inference, justification and cogency. This generalized and abstracted view of cognition supports coherentists in deflating the importance of epistemic truth, and it enables the substitution of new constructs, which can symbolize cogency and signify clear, broad and deep thinking. One example that I have found to be useful for pedagogical purposes has been provided by Rawls (1999), who described the idea of *wide dynamic reflective equilibrium* (WDRE) as a model of conceptual coherency. WDRE is the theoretical process of continually balancing a broad range of observations and conceptions in the process of forming and reforming the beliefs and the policies according to which we regulate our behaviour.

> Taking this process to the limit, one seeks the conception, or plurality of conceptions, that would survive the rational consideration of all feasible conceptions and all reasonable arguments for them. We cannot, of course, actually do this, but we can … characterize the structures of the predominant conceptions familiar to us from the philosophical tradition, and … work out further the refinements of those that strike us as most promising. (Rawls, 1999, p. 289)

The ideal of "widest" reflective equilibrium represents the most inclusive of possible sets of coherent ideas, a broadly based, and consistent, framework of observations, definitions and propositions which are justified by each other and by an absence of falsifying evidence. According to this theory, any belief that is contradicted by any confirmed observation, must be modified or discarded so that consistency is maintained, and all convictions that depend upon that belief for their justification, must also be altered or abandoned. This process of disequilibration, accommodation and re-equilibration, described variously by Piaget (1971), Schön (1991), Dewey (1933), and Mezirow (1987) is consistent with sociocultural learning theory, and it is facilitated by co-operative and progressive discourses amongst those who intend to maintain conceptual coherency (a useful objective for those who intend to attain cogent intellectual commitments, or to apply considerations of justice and morality in social relationships).

Philosophical Considerations

Considering the Pedagogical Value of Contemporary Ideas in Epistemology

Developments in philosophy during the last century have filtered through our educational systems to the point where they present serious difficulties to educators who intend to justify their teachings in terms of epistemic truth. On the other hand, many educational theorists and practitioners have recognized the importance of weak scepticism (the understanding that our knowledge beliefs, opinions, inferences and conclusions are at best uncertain) in facilitating metacognitive processes and cognitive development. In particular, we need to develop intellectual commitments to considerations of the reliability and the relevance of evidence, and to the development of coherent arguments (rather than to the regurgitation of historical presumptions). This approach enables us to provide frameworks for progressive educational discourses and for the development of newly created individual (or shared) understandings.

Contemporary philosophers have argued against the utility of epistemic *foundationalism*, which rests on the assumption that true assertions can be justified by fundamental (true, but unproveable) ideas. *Coherentist* forms of epistemology, which do not require fundamental truths as the bases for justification of our beliefs, allow for a different view of knowledge. The latter theoretical framework provides a perspective which allows for justification to occur through complex networks of inter-related ideas that are, in turn, supported by available evidence. This section describes how educators have exploited recent developments in philosophical theory to describe possibilities for understanding the idea of knowledge as being distinct from the notion of epistemic truth; emancipation from the oxymoron of true belief allows for deep and coherent sets of complex ideas without reliance on the outmoded idea of an absolute and fixed metaphysical reality.

The notion of epistemic truth, which is based on unshakeable (fundamental, or foundational) assumptions about the world is under attack. Pragmatism, a twentieth-century development in philosophy, holds that philosophical theorists (after a couple of millennia of debating about it) have failed to create a coherent understanding of this concept; pragmatists hold that *coherentism* (justification via systems of networks of consistent ideas, supported by available evidence) is a more utile philosophical perspective than one that relies on foundational truth. van Goor, Heyting and Vreeke (2004) argue against justification in terms of foundational principles, because contemporary critics hold that no such foundation may be considered irrefutable. These authors have argued that most contemporary philosophers of language reject classic foundationalism, along with the notion that language can accurately represent reality.

"Consequently, analytic philosophers now concentrate on describing rules for the correct use of concepts within conventional language games [Wittgenstein's term for the social contexts which give meaning to our utterances]. The conceptual clarification this kind of linguistic analysis promises is not accurate representation of external reality, but only correct *usage,* as compared to the specific language game in question" (van Goor, Heyting and Vreeke, 2004, pp. 176-177). Rather than establishing foundations, philosophy can fulfil its normative role through "contextual justification," which consists of suiting reasons to contexts.

To remain within the bounds of cogency, we must avoid dogmatic attachments to epistemically privileged assertions, or to any universal procedures for ratifying truth or standards of rationality. Given the failure of foundational epistemology, Child, Williams and Birch (1995) emphasize that epistemic justification relies on ethics (that is, the moral values which are reflected in the general aims and specific intentions of particular discourses and discussants).

Meaning-context theory stresses the local nature and relevance of any justification; this raises the problem of distinguishing multiple contexts and selecting one as an approach to a particular meaning, a process that obscures possible alternatives (creating blind spots). van Goor., Heyting, and Vreeke, (2004) note that one role of philosophy of education is to highlight this problem; assigning priorities to particular meanings in each situation. In particular, cultural hegemonies (authoritative presumptions) should be subject to discursive examination and assessment.

> As a consequence, any position one might take is put into perspective from the very beginning … philosophy of education consists in bringing to

> the surface any meanings one inclines to take for granted – a process that creates space for diversity, for 'the other' … [T]he relevance of philosophy of education consists in resisting the hegemony of the personal horizon. When persons open themselves to 'the other' in an existential sense, they will be able to avoid having their judgments determined by their preliminary personal position. (van Goor, Heyting and Vreeke, 2004, p. 187)

From the point of view of discourse-context theory, the primary task of philosophy of education is "making explicit and calling into question those conventions that people are inclined to take for granted and that result in exclusionary practices. This makes it possible to challenge the constraints of discourse-contexts, push them and shift them" (van Goor, Heyting and Vreeke, 2004, p. 188).

In a similar vein, Siegel (2006) argued that what counts as knowledge, what counts as evidence, and what counts as a warrant for evidence, vary according to community standards. He concluded that we need to adopt fair-minded locally neutral criteria for assessing local epistemic standards (since global perspectives are, in practice, unavailable), and that education in epistemology is required if we are to understand these issues.

On this philosophically pragmatic interpretation of academic understanding, the job of postsecondary educators is to learn, and to teach, the (discipline-specific) distinctions that characterize better and worse evidence, and better and worse interpretations. A post-modern philosophy of education de-emphasizes the authority of instructors, and places responsibility for discourse construction upon learners who seek initiation into their instructors' knowledge frameworks. Wenger (1998) stresses the importance of conversations at the boundaries of "communities of practice," where people whose backgrounds differ negotiate common terms and common understandings. Primary emphasis is placed on inclusion and integration, rather than truth. "[E]mphasizing the embedded nature of knowledge draws attention to the *inter*active dimensions of justifications" (van Goor, Heyting and Vreeke, 2004, p. 190, original emphasis).

Without reliance on epistemic truth to anchor our ideas, coherentists can substitute a different ideal to symbolize lucidity and cogency. John Rawls, the accomplished social philosopher, has provided a description of coherentist epistemology, which can serve to signify clear, broad and deep thinking. Rawls (1999) has described the idea of *dynamic reflective equilibrium* as a model of conceptual coherency. Narrow reflective equilibrium refers to situations in which the premises and the arguments in support of one's beliefs and one's actions are sound according to the rules and the principles, which govern the local settings in which the actions occur. For example., in a corporate environment, accepted norms might prescribe that executives engage covertly in illegal accounting practices in order to maximize the company's performance, and that they subsequently ought to protect themselves from liability by covering up their participation in such practices and denying their endorsement of covert illegal policies.

In Habermas' view, the practical applications of philosophical study are (in the best of possible practices) mediated through careful debate between rational interlocutors, and occur in the context of socialization *per* public norms. "The goal of communicative action is a rational consensus to be brought about by the interpretive accomplishments of the subjects involved" (Habermas, 1977, p. 76). We may infer that the disposition towards engaging in this sort of intellectual (metacognitive, regulative) functioning, including deep analysis of the consistency of our ideas, is very useful to most learners (including teachers) throughout their lifetimes, and that this affective inclination should be encouraged by teachers throughout their students' educational development

Epistemological Sophistication

Epistemological sophistication, a normative ideal that describes our understandings of how beliefs, opinions, assumptions and conclusions are formed and changed, is a crucial dimension of higher-order thinking. Educators who understand the benefits of epistemic sophistication may manage to communicate the delightful experience of achieving deep and coherent understandings of complex subject matter. In this respect, a basic pedagogical construct has been developed (that of *epistemological sophistication*, Hofer and Pintrich, 1997) which places a focus on the effects of learners' beliefs about knowledge and knowing. Perry (1970) interviewed 464 college students on their beliefs about knowledge and knowing in a four-year longitudinal study; this pioneering project led him to develop a scheme of nine stages of epistemological development. The lowest level (*basic duality*) is characterized by omniscient Authority delivering absolute Truth; the highest level entails *commitments* (affirmations) to a pluralistic and relativistic perspective, culminating in an experience of life (*developing commitment*) that is akin to Maslow's (1954) description of the fully self-actualized individual. Several other theorists have agreed that absolutism (absolute truth) is the lowest level of epistemological sophistication, while high levels of epistemic awareness have been variously described as contextual (Baxter Magolda, 1992), evaluative (Kuhn, 1991), constructed (Belenky, Clinchy, Goldberger and Tarule, 1986), and reflective (King and Kitchener, 1994). The similarities in the ideas presented by these theorists provide a remarkable consensus on at least a sub-optimal approach to defining stages teachers need to lead students through a good epistemological education.

The levels of awareness described in each of these theoretical perspectives support the pragmatic philosophical perspective that intellectual growth is severely limited if it occurs in an epistemic framework of absolute truth, according to which human understanding is seen as the manipulation of already-formed ideas. In contrast, higher levels of understanding are characterized by the development of critical insights through deep and reflective evaluation of ideas and evidence (in particular contexts, and facilitated by progressive social discourses). Thus, the understanding that knowledge can be gained through the acceptance of received information from authoritative sources is (epistemologically and pedagogically speaking) far inferior to the idea that cognitive growth depends on deep and thoughtful analysis of the evidence, and of the assumptions that justify our ideas.

In another empirical investigation of the relevance of epistemic beliefs, Schommer (1990, 1993) used questionnaires to survey high school students and university undergraduates on their epistemic views. Her findings upon correlating her results with academic achievement indicate that those who believe that advanced knowledge is easy to acquire, or that it can be gained through an accumulation of simple ideas, are likely to fail in the quest for higher-order understandings. This relates to Bereiter's (2002) argument that educational reform needs a new theory of mind that would enable educators to teach for the type of deep understanding that enables learners to cope with the ill-structured applications, which are encountered outside of schools. Bereiter (2002) points out, "The most basic of [educational] tools are our conceptions of mind and knowledge" (p. 4), and he concludes that the theory of mind as a container of knowledge objects is insufficient to support the flourishing of future citizens.

Taken together, Schommer and Bereiter have indicated that (to create a progression of deeper and more coherent understandings) we must be prepared to move away from an acquisition model of knowledge and knowing, to a view of knowing as a continual and fluid process of creating and modifying our ideas in the light of new evidence. Higher cognitive development demands that we continually create new discourses to provide ourselves with better understandings of that which we have known before. In particular, new discourses about knowledge and knowing can indicate to young students that they won't find knowledge in schools or in books; they must work out their ideas in their own ways, and for their own purposes (with the benevolent support of their teachers, who must do the same for themselves). When we work out our ideas in company with others, we create common understandings.

Hofer and Pintrich (1997) have described the conclusions of research into the role of epistemic beliefs in cognitive development. The similarities of the individual continua provided by various theorists point to a consensus which seems to have been informed by a common understanding of contemporary developments in educational philosophy. In particular, the weak sceptical approach is consistent with the rejection of the use of fundamental beliefs, which are assumed to be true, as appropriate bases for philosophical (epistemic, metaphysical, ethical or aesthetic) justification. Instead, all pedagogy is based on the acceptance of the idea that the best knowledge humans can articulate can only be justified by the coherency of a large number of (uncertain) beliefs which are mutually consistent with each other, each of which is supported by the best available evidence and the most careful (that is, most *expert*) analysis of alternative interpretations.

Ethics and Education

Koetting and Malisa (2004) have noted that philosophical inquiry is normative, driven by and assessed in accordance with social values. It is also analytic (concerned with the use of language and concepts). They regard education as a moral undertaking, and they hold that educators are morally obligated to inquire (analyze, critique, theorize) into education theory, philosophy, and research. Noddings (1984) wrote, "The primary aim of all education must be nurturance of the ethical ideal" (p. 6). I hold that one aspect of higher-order thinking applies to considerations of ethical issues, which address problems regarding the negotiation of standards for proper or improper behaviour in social situations. I also follow Aristotle (and Ennis, 1998) in holding that the disposition to think in terms of ethical considerations (that is, caring for the interests of others) represents one aspect of higher-order thinking.

In *Nichomachean Ethics*, Aristotle (1962/2000) discussed virtue as a commitment to lead a good life; the highest good for Aristotle is "an activity of the soul in conformity with excellence or virtue, and if there are several virtues, in conformity with the best and most complete" (1098a, 16-17). Virtue is not a function of doing the right thing; rather the term refers to practical wisdom and the effective performance of the right (or the best) actions. As an attribute of character, virtue may be understood as a commitment to behave well (to do the right thing, whatever the right thing might be in any given situation). Virtuous people characteristically manage to enact the intention to do that which is morally correct. It is important to note that, for the purposes of any such discussion, it must be assumed it is somehow possible to determine what is or is not considered to be correct under particular circumstances; this is a cognitivist theory of moral virtue. Practical wisdom is manifest (in varying degrees) in our assessments of what is correct in each case; again, for this discussion to be cogent, it must be understood that the possibility of making a "correct" moral choice is granted.

Cogent moral judgments entail a clear reckoning of particular situations, and also an educated recognition of what is at stake with regard to moral claims (assertions of moral value). The salient considerations in each case are combined and weighed in a reflective normative assessment, a moral judgment. The greatest difficulty in ethical analysis may not be the definition of ideal practices, but rather the applications of such theoretical notions in actual practice.

Noddings (2007) describes Aristotle's idea that "Children … should be taught to behave virtuously. The virtues identified in the very best citizens were to be inculcated at appropriate ages in children" (p. 166). She claims that character education (in the United States) is currently undergoing a revival, and that "Recognition of the pluralism of values … suggests the need for careful analysis of the virtues …"(p. 168). However, the most basic moral issue remains that of caring for others, the consideration of the interests of others as well as one's own. This "social contract" (originally described by Hobbes, 1981, as the only means for escaping from primitive egocentric amorality), should extend to every human relationship. This leaves us with the constant problem of balancing people's interests in our every social endeavour (which may call for careful consideration of complex ethical problems).

Nussbaum (1990) wrote that Aristotle's (1962/2000) account of virtue ethics captures "the sheer complexity and agonizing difficulty of choosing well" (Nussbaum, 1990, p. 55). While rules could play an important role in practical reason, situational judgment is required in the application of practical wisdom. Insight is gained through experience, and long practice of ethical discrimination enables one to grasp "the subtleties of a complex ethical situation [which] must be seized in a confrontation with the situation itself" (p. 69). "Excellences are the ultimate bearers of value; virtue is embodied in the pursuit of excellence, and this quality can be an attribute of various forms of action. Each form of value contributes "to the richness and fullness of the good life" (p. 60). Virtue and practical wisdom are two components of Aristotle's description of human flourishing (*eudaimonia*). Reflective contemplation, which is characteristic of moral virtue, may be applied to the consideration of the values by which we guide our actions, especially when conflicts occur. Good deliberation is compared to improvisation, for the human needs and concerns to be considered in every situation are unique to those particular circumstances. It is important to note the relevance of deliberation in conducting a virtuous life; the attention to moral reasoning is a significant feature of the search for excellence.

Hursthouse (2001) emphasizes the essential point that, in addition to guiding adults with respect to correct moral behaviour, any normative ethics must "generate some account of moral education, of how one generation teaches the next what they should do" (p. 38). This is crucial, because if a minimally adequate moral education is not provided to future generations, then it is less likely that a society will be developed wherein people will be concerned with working well together or with distinguishing beneficence from maleficence. Hursthouse explores the virtuous agent's reasons for action; she claims that "moral motivation," far from being left out of the application of virtue ethics (as some theorists have implied), is an important feature of virtue theory. She makes the point that moral motivation is one aspect of the character of the practically wise agent, who discerns and performs morally correct actions.

Noddings (1984) promotes the idea that caring is a requisite for the most successful educational practices; she defines moral education as carrying a double meaning. "It refers to education which is moral in the sense that those planning and conducting education will strive to meet all those involved morally; and it refers to an education that will enhance the ethical ideal of those being educated so that they will continue to meet others morally" (p. 171). Morality is closely associated with reason. "One cannot dismiss thinking and reasoning from ethical conduct … I must think effectively about what I should do in response to the other" (p. 171). It is important that educators "emphatically" reject the idea that home and church are the exclusive exemplars of moral conduct, while schools "train the intelligence"; rather, "The primary aim of every educational institution and of every educational effort must be the maintenance and enhancement of caring … It establishes the climate, a first approximation to the range of acceptable practices, and a lens through which all practices and possible practices are examined" (pp. 172-173).

Inferences Regarding Philosophical Bases of Higher-Order Cognitive Development

Since understanding is an essential educational goal (upon which higher cognitive functions such as analysis, evaluation and synthesis are based), learners who are committed to clarity and cogency should learn to comprehend contemporary views of knowing and understanding. We cannot cultivate coherent thinking without recognizing the bounds of coherency. While the vagaries of epistemology may be confusing upon initial exposure, the value of gaining a variety of perspectives on the subject may well be worth the time and the effort that are required to do so. Educators and their students may ground themselves in contemporary philosophical ideas, which hold that the objective of understanding is cogency (appropriate local justifications), rather than (universal) truth, and that the philosophical emphasis of education can be placed on human flourishing: virtue, caring, and utility.

The Psychodynamics of Cognitive Transformation

In this section, I describe how evidence that contradicts our beliefs (leading to cognitive disequilibration) can be used to trigger the "unlearning" of dysfunctional cognitive schemes, in order to allow the learning of new ones that can be applied more coherently. I will relate this (transformative) type of learning to the notion of using education to emancipate students from authoritative knowledge regimes through the development of critical discourses, deep reflection, and the renegotiation of meanings.

The Possibility of Transformative Learning

Cranton (1997) wrote, "We need to be open to alternative perspectives in order to transform our own" (pp. 2-3). Several theorists have stressed the educational importance of surprising evidence, events which apparently disconfirm our beliefs; such experiences indicate (to analytical thinkers) an opportunity to modify our conceptions to improve their consistency and coherency. Piaget (1971) wrote of *disequilibration,* which stimulates cognitive restructuring until one's ideational processes achieve re-equilibration. Schön (1987) remarks upon the *element of surprise*, the failure of events to meet expectations; he points out that unexpected confusion is a result of an inadequate hypothesis. This experience leads to *reflection-in-action*, a pattern of inquiry and rethinking which leads to *unlearning*. Learning is cognitive work, the reconstruction of experiences in order to arrive at new understandings of action situations. It is questioning the assumptional structure of knowing-in-action in order to restructure strategies of action, and it serves to reshape what we are doing while we are doing it.

Mezirow described the importance of *disorienting dilemmas*, which occur when present experience invalidates old understandings; this produces a sense of inadequacy, a realization that one's old ways of seeing meaning are unsupportable, and that one's old patterns of response are ineffective (in relation to one's aims). Such an experience may be very painful, and threatening to one's identity (since we identify with our frameworks of belief and meaning). Reflection on potentially dysfunctional assumptions is central in the transformation of meaning schemes and perspectives; *validity testing* "may result in the elaboration, creation, or transformation of meaning schemes" (Mezirow, 1991, p. 6). *Transformative* learning is the revision of meanings through the alteration of *meaning schemes* and *meaning perspectives*; the former are particular beliefs, judgments and habits of expectation, while the latter term represents tacit and presumptive conceptual structures (interrelated meaning schemes), within which ongoing events are being dynamically related to past experiences. Mezirow acknowledges that people construct reality dynamically through different discursive contexts associated with various types of activities. "As far as any particular individual is concerned, the nature of a thing or an event consists of the meaning that that individual gives to it" (Mezirow, 1991, p. xiv).

Mezirow's transformative learning theory concentrates on how meaning is developed ("construed, validated and reformulated"); it was designed as "a firm foundation for a philosophy of adult education from which appropriate practices of goal setting, needs assessment, program development, instruction and research could be derived" (Mezirow, 1991, p. xii).

Meaning perspectives are akin to Kuhn's *paradigms*, Goffman or Bateson's *frames*, and Wittgenstein's *language games*. In a shared social reality, where meanings are continuously negotiated through communication, values (definitions, assumptions, categories) are internalized by each individual; personal history determines what we can know and how we can know it. As historical authorities break down, new meanings are negotiated, and new authorities may be more democratic/educative. "Thus it becomes crucial that the individual learn to negotiate meanings, purposes, and values critically, reflectively and rationally instead of passively accepting the social realities defined by others. Transformation theory provides a description of the dynamics of the way adults learn to do this" (Mezirow, 1991, p. 3). "Transformative learning is learning through action, and the beginning of the action learning process is deciding to appropriate a different meaning perspective" (Mezirow, 1991, p. 56). Thus the application of reflective retrospective analysis to one's conceptual frameworks, in order to modify one's ways of thinking, can produce discontinuous leaps in cognitive development.

Communicative action (Habermas, 1984, 1987), the intersubjective construction of consensual meanings, requires agreed upon means of validity testing, the application of validity criteria (or *grounding*) which are refined through speech, to explicit and implicit claims. Transformed meaning schemes lead to assessing and redefining critical assumptions, "becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand and feel about our world. Changing our structures of habitual expectation makes possible a more inclusive, discriminating, and integrating perspective; and finally, making choices or otherwise acting upon these new understandings" (Mezirow, 1991, p. 167). Transforming our meaning perspectives give rise to new ways of experiencing and of interacting with people and things, ways which may allow us to resolve previously insuperable difficulties.

Education as Emancipation

Some view education as providing an opportunity to escape the domination of those who wield authority and power in social groups, since the dominance of power brokers has not always served the majority of citizens. Foucault (1980) wrote, "[T]here are manifold relations of power which permeate, characterize and constitute the social body, and these relations cannot themselves be established, consolidated nor implemented without the production, accumulation, circulation and functioning of a discourse" (p. 93). Perhaps the most relevant discourse in this respect is that which deals with the object to which we refer as *truth*. "We are subjected to the production of truth through power and we cannot exercise power except through the production of truth ... in the end, we are judged, condemned, classified, determined in our undertakings, destined to a certain mode of living or dying as a function of the true discourses which are the bearers of the specific effects of power" (Foucault, 1980, pp. 93-4). Power has evolved from the exclusive property of theocrats and aristocrats to a more widespread form of domination, namely disciplines, which require that people comply with various authoritative regimes. Emancipatory, or autonomous, thinking is the process of creating idiosyncratic and creative conceptual frameworks.

As Jefferson and the American founding fathers created a framework of freedom from oppressive sovereign authorities, Foucault's discourse has formed a basis for the contemporary ideal of emancipation from oppressive and authoritative knowledge regimes. As the reliance on scientific truth provided the justification for enlightenment philosophers to wrest intellectual authority from the ecclesiastics, the critics of scientism (who deplore the elevation of science as the sole source of epistemic truth) contend that post-modern criticism justifies the devolution of responsibility for knowledge construction from authoritative instructors to inquiring learners. Freire (1970) has inspired contemporary proponents of emancipative education to overcome the "fear of freedom" (doubts with regard to possible outcomes of overcoming oppressive authorities), acknowledge their victimization, and "find through their struggle the way to life-affirming humanization" (Freire, 1970, p. 55). Freire (a Brazilian) was concerned about the economic exploitation of powerless peasants by oppressive sovereign regimes; his successors in progressive pedagogy, observing the globalization of power and authority, have expanded the discourse, examining the hegemonic perspectives which have the effect of dividing people into sectarian, ethnic, racial and gender groups.

Cultural hegemonies apply at practically all levels of social interaction (including, of course, our universities). McLaren & Giroux (1997) credit language as the vehicle for identity, knowledge and power.

> As a political issue, language operates as a site of struggle among different groups who for various reasons police its borders, meanings and orderings.

> Pedagogically, language provides the self-definitions upon which people act, negotiate various subject positions, and undertake a process of naming and renaming the relations between themselves, others and the world … As the cultural mask of hegemony, language is being mobilized to police the borders of an ideologically discursive divide that separates dominant from subordinate groups, whites from Blacks, and schools from the imperatives of democratic public life. (McLaren & Giroux, 1997, p. 16)

These authors claim that many progressive education theorists have failed to theorize *for* schools while theorizing *about* them. The importance of (nonfoundational) pragmatic philosophy is emphasized in the recognition that social reality is constructed through linguistic discourses, which reify various authoritative ideologies. "In order to break free from the prison house of language as students, teachers, and researchers, we need to understand that reality is not co-extensive with the categories of discourse, since failing to do so means limiting social change to the permutations of discourse within the same set of categories" (McLaren & Giroux, 1997, p. 29).

Transformative and emancipatory education clearly goes beyond furnishing knowledge to inquiring learners in the hope that they will adopt the methods and the understandings of their intellectual forebears. Teachers may learn to recognize the philosophical fallacies and the psychological barriers (their own, and those manifested by their students), which prevent the recognition of dysfunctional conceptual frameworks (maladaptive beliefs accompanied by a psychological reluctance to adapt); inconsistency and incoherency may be corrected through reflection, re-evaluation, problem solving and validity testing. The job of an inquiring learner is the continual creation of transformed knowledge frameworks, which are established by modifying prior understandings through critical assessment. However, this cognitive work is hampered by affective processes; as Boler (1999) has described, emotional attachments to our historical understandings may pose barriers to learning new perspectives.

Teaching for Transformation

Schön describes the activities of the reflective practitioner as a form of artistry. His construct of *reciprocal reflection-in-action* (like Habermas' *communicative action* and Mezirow's *reflective discourse*) depicts an ideal educational commitment; instructors are coaches who suit their discursive actions not only to the actions of their students, but who also take into account the learners' tacit understandings (and their own presumptions as well). Self-critical analysis allows coaches and students to adapt their skills to situational contingencies. "Reflection-in-action becomes reciprocal when the coach … responds to [a student's] interpretations with further showing or telling, which the student may, in turn, decipher anew and translate into new design performance" (Schön, 1987, p. 101). The artistry is collaborative, as instructional methods, desired outcomes, and assessment criteria are invented through co-operative practices.

Brookfield (1995) elucidates his own experiences of being a reflective practitioner, describing the process for those who recognize the importance of continually adapting to the contingencies of teaching and learning situations. "Critically reflective teaching happens when we identify and scrutinize the assumptions that undergird how we work. The most effective way to become aware of these assumptions is to view our practices from different perspectives" (Brookfield, 1995, pp. xii-xiii). These perspectives comprise various dimensions; some are autobiographical, others are gained from students, colleagues and literature. In particular, Brookfield recommends the literature of critical pedagogy as a tool for the facilitation of practitioners' development; he describes critical reflection as "anchored in values of justice, fairness, and compassion … critical reflection urges us to create conditions under which each person is respected, valued and heard" (Brookfield, 1995, pp. 26-7). Critical discourse is essential to development, in that it is used to illuminate the deleterious effects of power structures (and their associated hegemonic precepts), and to validate our justifications in all areas of inquiry. The possibility of reciprocal criticism (based on consensual reasoning) places responsibility upon all discussants to clarify their own perspectives, and to modify them when they are exposed as being inadequate or inappropriate to the (most benevolent) purposes at hand.

Learning different perspectives on our practices, and reinterpreting the assumptions that underlie them, exposes the errors of our ways, which only become subject to correction after they are revealed through criticism, analysis, and reflective evaluation. For example., Brookfield realized (after interviewing his students specifically to learn their perceptions of his methods) that his commitments to humility and to allowing his students to express themselves were perceived as evasion of the issues at hand, and that his intentional avoidance of autobiographical disclosure was seen as a failure to participate authentically. These (transformative) revelations allowed the author to improve his practice in these areas.

Some educational techniques have been developed specifically to exploit the possibility of self-reflection in group environments; the use of group therapy has long been recognized as an invaluable tool in psychology and psychiatry. Carl Rogers developed the idea of group awareness training in order to make use of the social (*intersubjective*) aspects of the learning process; more recently Revans (1983) has promoted a theory of *action learning*, which calls for a group of associates, led by a trained facilitator, to clarify common problems, examine alternative actions, and work through their difficulties in communication (logical, philosophical or psychological) in order to learn how to improve their performance. Boyd (1989), in order to support adult educators in facilitating transformational learning ("a fundamental change in one's personality involving the resolution of a personal dilemma and the expansion of consciousness resulting in greater personality integration" p. 459), describes a model of group dynamics, which incorporates adaptive psychological elements, structural factors, and developmental processes.

Leonardo (2004) promotes critical social theory as an approach to learning that rejects any radical distinction between theory and practice; he promotes transformative learning as that which broadens and deepens students' thinking to promote emancipation from oppressive knowledge. According to Leonardo, criticism targets the institutional arrangements that systematically distort communication, allowing us to confront such issues as social inequality. He values debate, openness to different ideas, and commitment to democratic processes, claiming that, "Quality education is proportional to the depths of one's analysis" (Leonardo, 2004, p. 14), and that the critical process (synonymous with quality education itself) creates a "never-ending process of liberation, of deferred and multiple emancipations" (p. 16).

Transformative learning theorists warn of two sets of difficulties which are often encountered when we recontextualize our historical understandings through reflection without a reliance on foundational epistemologies, and it is important that educators and their students are aware of these potential pitfalls when engaging in communicative action with the intention of altering meaning perspectives. The first type of difficulty is psychological: it can be very difficult for people, who are used to relying on hegemonic presumptions based on authoritative and reliable absolute truths, to form coherent ideas outside of the foundationalist frame. Boler (1999) has described how emotional attachments to our historical understandings may pose barriers to learning new perspectives; when faced with evidence contrary to their ideas, we may retreat to dogmatic certainty, dismissing the evidence without reflecting upon potential alternative explanations that would be inconsistent with their already-understood ideas. Committed fundamentalist thinkers can become very skilled at justifying every possible circumstance on the basis of a few ungrounded assumptions. Even if learners are sincere about their intentions to restructure their ideas, facing a disorienting dilemma (which, to a learner experienced in transformative thinking, calls for reflection and recontextualization) can result in a discomfiting uncertainty (perhaps rising to the level of anguish), which might compel one to escape a potential learning situation and to avoid educational environments where reflection would be beneficial.

The second set of difficulties is political; many university professors and administrators are committed to foundational principles (Sterman, 2001; Halpern, 2002; Scanzoni, 2005; Inderbitzen and Storrs, 2008; Condon, 2008). Until theories of transformational learning are fully accepted in the academic mainstream, they may be viewed with suspicion (or rejected outright) by those who are unacquainted with its discursive roots in philosophy and psychology, or by those who are adamant in their opposition to departures from traditional curricula.

Empirical Work

My literature searches of educational research on transformational learning did not uncover a large number of empirical studies; however, the ERIC database revealed several examples of qualitative investigations of related phenomena.

In a study of graduate students who took a course in Theory and Dynamics of Intercultural Education, Greenman and Dieckmann (2004) reported on interviews of seven students and their instructor, who were asked about their experiences with regard to the efficacy of criticality (identifying critical issues, discussing them in depth, and applying the critical lens to practical issues) and its relationships with transformative learning. Qualitative data analysis revealed that the professor was conscious of a "zone of discomfort" in pursuing deep inquiries into students' thinking; one student reported that the discomfort was "sometimes overwhelming." The results also indicated course design elements that facilitated deep reflection; these included combining rigour with joy and humour, applying flexibility in negotiating the syllabus, and creating psychologically safe opportunities for student engagement. Students reported "profound and often painful shift[s] in, and understanding of, personal identity" (Greenman and Dieckmann, 2004, p. 250); the process opened new ways of seeing and understanding their lives and their relationships with others. In addition, these new understandings were applied to their work as teachers; as the researchers reported,

> Students realized the naiveté in their initial attempts to fix what was broken as they were more able to identify hegemony in context and were battered against structural barriers; students quickly realized the boundaries of their human agency within schools and institutions.

> Eventually, each former student gravitated toward a piece of the perplexing equity puzzle, striving to grasp, grapple with, and integrate their constantly changing insights about culture as a pivotal dimension to their work. (Greenman and Dieckmann, 2004, p. 251)

Brown (2006) describes a pedagogical approach in which, "Transformative learning is a process of experiential learning, critical self-reflection, and rational discourse that can be stimulated by people, events, or changes in contexts that challenge the learner's basic assumptions of the world. Transformative learning leads to a new way of seeing" (p. 706). Her purpose is to apply critical social theory to critical reflection, rational discourses and policy praxis; she claims that, "Before future educational leaders for social justice can take action, they need to increase their awareness of sociopolitical and sociocultural constructs and then acknowledge the importance of understanding and discussing such difficult issues related to race, class, gender, and difference" (Brown, 2006, p. 712). Brown studied forty graduate students enrolled in a course called The Social Context of Educational Leadership by examining 1200 weekly entries in their reflective analysis journals; she found,

> During a 2-year period, students wondered, questioned, and hesitated. They reportedly stretched themselves, pushed their boundaries, grew, and developed. Many of the learner responses were emotionally laden. At times, they revealed being amazed, enthralled, awakened, and grateful. At other times, they were afraid, stressed, angry, and guilt ridden. Some of the students described the strategies used as growth inducing, perspective shifting, and life changing. And although certain experiences were

> meaningful to certain individuals for certain reasons, collectively, the andragogical processes and strategies used seemed to have a transformative impact on the majority of the students. (Brown, 2006, p. 712)

Brown noted that, "The process of transforming meaning structures is a complex, arduous task" (p. 721), and, "Establishing a dialogic context ...can be complicated, difficult, and frightening for students and professors alike" (p. 725). However the results indicated that the students made great strides in recontextualizing their experiences, and in realizing the value of changing their perspectives.

> By assessing and examining current procedures and then reordering and restructuring their practice according to a new agenda of social action, some of the preservice leaders reportedly began to engage in a developmental process of 'deconstruction and reconstruction.' Their implementation efforts yielded mixed results in terms of behaviors, boundaries, alternatives, and consequences. The students struggled with their role as student-intern, with their ability to be proactive versus reactive, and with their willingness to embrace conflict rather than avoid it. (Brown, 2006, p. 729)

Brown concluded, "preparation programs must expose preservice leaders to critical social theory and its influence on the purposes of schooling" (p. 731).

Inderbitzen and Storrs (2008) reported on their attempts to implement a transformative pedagogy to create a collaborative learning community at Oregon State University. Implementing a yearlong course on educational issues in America, the authors wanted to "emphasize educational inequalities and the relationship between education and society, including the bureaucratization, rationalization, and McDonaldization (Ritzer 2000) of education, and to examine social interactions within schools" (p. 48). Following Giroux (2001), they intended to question the practices used in public, and higher, education in American schools. The researchers found that

> Students came to a better understanding of the power of social structure to shape an individual's educational experience and identity ... The most unexpected finding for us, as university professors who sometimes chafe under the constraints of working in bureaucratic institutions of higher education, was the intractability of the instructional paradigm. In debriefing the simulation, we learned that our state university students ultimately found comfort in the dominant learning structure and would be at least initially resistant to moving toward a more flexible learner-based curriculum. (Inderbitzen & Storrs, 2008, p 49)

Sockman and Sharma (2008) reported on Sockman's experiences of moving her instruction style from a *transmitter model* to a *transformative model* of thinking (with the guidance of her co-author) while teaching educational technology to 14 undergraduate students. Her insightful autobiographical narrative relates the difficulties that she encountered as she found herself enmeshed in transmitter thinking; her struggles triggered extensive self-reflection as she worked to reveal the preconceptions, and the entrenched habits of action, that resulted in failure after failure to question her students thinking, or to allow them to articulate their assumptions, their experiences, and their logic. By examining her beliefs and her practices, Sockman was able to deal with her own resistance to change; by submitting herself to questioning, she was able to undergo deep learning, and model the process to her students. "However, the self-examination took intellectual courage … [T]he instructor needed to make her academic-self vulnerable to the emotions of inward struggle in order to improve pedagogical practice" (Sockman & Sharma, 2008, p. 1080).

Inferences Regarding Transformational Learning

I infer that learning is sometimes discontinuous rather than incremental; breakthroughs in thinking are achieved through changes in perspectives (changes in the meanings of ideas), which produce disorientation (disequilibration), accommodation (re-contextualization), and re-equilibration (the restoration of consistency through the resolution of dissonant cognitive elements). Breakthroughs are facilitated through detachment from linear ("single-minded") approaches and the synthesis of alternative perspectives; they can be facilitated through discursive support from mentors and peers. It also seems that attachments to (that is, identification with) dysfunctional ideas may result in cognitive self-transformation sometimes being accompanied by emotional discomfort (which I represent as cognitive growing pains). It also appears that institutions that are well entrenched in social infrastructures (such as universities) do not easily transform their structures to accommodate new operational paradigms.

Designing Instruction to Facilitate Higher-Order Thinking

Learning Environments

The practices of instructional design have progressed past the ancient paradigm in which instructors present information and students store it (the "banking," or transmission, model of instruction). While this form of instruction has its place in schools (especially for young learners or introductory lessons, where students need to acquire information before they can consider its implications), advanced instruction for higher learning requires deeper inquiry, and more (analytical and progressive) discussion, on the parts of both teachers and students. The learning and teaching of higher-order networks of ideas require a more complex and dynamic paradigm than the transmission paradigm; fortunately, recent work in educational psychology has provided a wealth of contemporary theoretical frameworks as resources for instructional designers.

For example, Spector (2001) discussed how to support learning in and about complex domains. He recommended that instructors adopt an integrated and holistic view of instructional design, which includes applying theories to practice. To create instruction that supports learning (defined as persistent changes in ideas, beliefs, attitudes and skills), instructors must carefully, and ongoingly, assess the effectiveness of their work (and that of their students). Spector emphasizes the epistemic components of instructional design, underlining the importance of recognizing and understanding the limits of reasonable justification (the "bounds of sense"). He recognizes that theories of truth have been demonstrated to be "problematic," and that meanings are determined by usage in social contexts. He also notes that higher cognitive development requires the adoption of a sceptical perspective: persistent questioning (of oneself as well as of others), a detachment from the certainty of any conclusion, and the recognition that perception (direct evidence) trumps conception (belief). Spector promotes an *Integration Principle*, which holds that experience is not compartmental, multiple approaches to leaning are beneficial, and whole-task activities should be preferred to part-task activities. He also formulates an *Uncertainty Principle* for instructional design, which claims that knowledge of instructional principles is always incomplete, and (reminiscent of Schön's *reflection-in-action)* instructors must discover what works best in each situation.

According to van Merriënboer (1997), understanding complex cognitive skills is a process of "describing relationships of different aspects of environments, learning processes, and learning outcomes. A good understanding of those relationships is believed to be helpful to the instructional design process" (p. 6). van Merriënboer points out that instructional design models may be descriptive (of the interactions between learning processes and instructional environments), prescriptive (goal-oriented and method-driven), or both. He recommends the last approach for training complex skills, and he combines descriptive and prescriptive elements in a four-component model for instructional design, which comprises *skill decomposition*; *analysis of constituent skills and related knowledge*; *selection of instructional methods*; and *developing learning environments*.

Elaborating on early work by Bruner (1966), Willis and Wright (2000) describe the possibility of reflective and recursive design and development, in contrast to the classic sequence of defining instructional goals, designing the instruction, development, and implementation. Their scheme requires that these steps be iterated as needed, providing a flexible cycle of design, implementation, assessment and redesign (a "spiral" model). Learning objectives emerge as the process develops, and all the steps are iterated repeatedly. Multiple problems are progressively solved in context; this requires "cooperative inquiry," the ongoing gathering of data to ongoingly assess and improve teaching and learning processes; this includes developing and clarifying a team vision of intended results, and considering feedback from students.

In consonance with the perspective of recursive design, Lee and Park (2008) describe the possibility of *adaptive instructional systems*, which are designed to "accommodate the needs and abilities of different learners … The development of computer technology has provided a powerful tool for developing sophisticated instructional systems from diagnostic assessment tools to tutoring systems generating individually tailored instructional prescription" (p. 470). Baek, Cagiltay, Boling and Frick (2008) promote *user-centred design and development*, which is intended "to place users at the centre of the design process from the stages of planning and designing the system requirements to implementing and testing the product" (p. 660). Although these two teams focused on the design of computer-assisted instruction, the principles of learner-centred instruction (which require adapting instruction to the needs of learners) are important guidelines for all kinds of educative processes (American Psychological Association, 1995).

Winn (2002) describes the current era of instructional design as the "age of simulations," in which interactivity allows for learner control of learning environments, including "authentic" applications that emphasize social learning. The focus is on (natural or artificial) safe learning environments, with limited freedom to act (so as to limit any damage that might result from learners' mistakes). The use of "inscriptional systems," representations such as models, datasets and virtual environments, allows for deep learning and mastery of subject materials. Peer support and discourse analysis can be used to understand students' thinking; teachers must understand, explain, and clarify the use of reifications and metaphors. Technology should be supplemented by clear purpose and face-to-face communication. The social context of instruction should provide students with the freedom to err, and the freedom to modify the learning environment. We can locate, within this context, the theory of *problem-based learning*, which provides opportunities to learners to solve authentic problems. "During the problem-solving process, students construct content knowledge and develop problem-solving skills as well as self-directed learning skills while working towards a solution to the problem" (Hung, Jonassen and Liu, 2008, p. 486).

Other educational researchers have provided valuable insights into techniques for facilitating higher-order thinking. For example., Azevedo (2005b) described computer-assisted instruction that aids learners in developing metacognitive self-regulation. His description of these "metacognitive tools" includes the following six characteristics:

> 1. It requires students to make instructional decisions regarding instructional goals… 2. It is embedded in a particular learning context that may require students to make decisions regarding the context in ways that support successful learning … 3. It is any computer-based environment that (to some degree) models, prompts, and supports a learner's self-regulatory processes … 4. It is any environment that (to some degree) models, prompts, and supports learners to engage or participate (alone, with a peer, or with a group) in using task-, domain-, or activity-specific learning skills … 5. It is any environment that resides in a specific learning context where peers, tutors, humans or artificial [intelligence] may play some role in supporting students' learning by serving as external

regulating agents ... 6. It is any environment where the learner's use and deployment of key metacognitive and self-regulatory processes prior to, during, and following learning are critical for successful learning (Azevedo, 2005b, p. 194).

While these descriptions were developed as being applicable to technological tools, the same principles can be useful to any educator who intends to design instruction that supports and facilitates metacognition and higher-order thinking.

Adopting a dynamic systems approach to educational psychology, Young (2004) promotes an "ecological psychology" of instructional design, which describes learning and thinking by "perceiving-acting systems." This model is consistent with contemporary philosophical schemes that concentrate on the dynamic complexity of interacting "psycho-physico-chemo-biologic learning systems" (p. 169). Ecological psychology interprets behaviour as an emergent result of self-organizing learning systems; learners are self-directed, creating "goal spaces" which contain potential trajectories from current states to potential future states. This allows for consideration of their intentionality and their intentions. Practicing with the materials changes learners' perceptions, including their perceptions of their environments. Feedback allows for transfer of "action and control parameters" from teacher/model to learner/cognitive apprentice; learning (a process of discrimination and differentiation) results from continuous, dynamic, embodied learner/dynamic-environment interactions (coupled feedback associated with control and action parameters). Learning attunes our intentions and our attention with regard to invariant properties of learner-world systems. We learn to detect *affordances* (Gibson, 1986), or possibilities for action, which represent opportunities to act that are provided by the environment. *Effectivities* represent an agent's skills or abilities to use the affordances that the environment provides. To create effective instructional designs, educators must understand how goals organize behaviour. Instead of adding information to learners' stores, educators can focus attention on available affordances. In this framework, it is essential to induce students to adopt learning goals that are related to the learning materials and environment. Barab and Roth (2006) extended this idea, describing the purpose of learning processes as "increasing possibilities for action in the world … Transfer can occur when individuals begin to see different contexts as having similar underlying affordance structures—even in the context of differing contextual particulars. In the best cases, individuals appreciate the power of, or adopt commitments with respect to, a particular effectivity set and begin to assert this 'toolset' in multiple situations even when the affordances are not readily apparent on the surface" (p. 11).

Emphasizing the social networking aspect of cognitive development, and building on Bruner's idea that four principles govern learning relationships (agency, reflection, collaboration and culture), Brown (1997) set about creating a social mentality of support for inquiry, reflection, and collaborative learning. The evidence that she describes with regard to the benefits of this type of thinking can inspire educators to create educational environments which take into account various crucial aspects of learning and teaching: that education is a cultural process, that reflection is essential to accommodate to the process, and that deep learning requires collaborative work. Educators have emphasized the relevance of the social processes that facilitate learning; sharing the affective and cognitive processes involved in restructuring our ideas is an essential part of cognitive development, and building our relationships with mentors and peers is a powerful way to support learning processes. The power of our learning networks is affected by the administration of the institutions that govern our educational systems; the following section describes some of the relationships between learning and teaching processes within institutional power structures.

Institutional Factors

Scanzoni (2005) presents a series of attestations, from university faculty and administrators, who agreed that most institutes of higher education in America had not yet come to grips with the "profound changes" that society has undergone in the past few decades. To overcome the deep resistance to change that pervades the academic world, Scanzoni has called for social scientists to "engage public officials, citizens and students in exploring [socially useful] innovations" (Scanzoni, 2005, p. xi). He recommends that social scientists take the lead in reforming education, switching from a [teacher-centred] *instructional* paradigm to an inquiry-based *learning* paradigm. He also recommends that instructors and students engage in action research in order to engage students in their studies, to increase the value that universities bring to education, and to "contribute to a more thorough and comprehensive understanding of the social world"(Scanzoni, 2005, p. xii).

Scanzoni's review of scholarly literature on the quality of undergraduate education in the United States concludes that students need not accomplish very much to obtain As and Bs. However, the core cognitive skills generally have received little attention. "More than anything else, say the critics, professors have the moral obligation to cultivate students' human capital skills, including the capability to analyze, evaluate and synthesize, and thereby to demonstrate their problem-solving capabilities" (p. 7).

Scanzoni claims that social scientists have been failing in their obligation to contribute value to society at large. "[S]ocial scientists have faltered by failing to take the lead in this regard. Coming up with inventions for resolving social issues, that is, creating a more just and equitable society, is after all a matter that falls squarely within the domain of social sciences" (pp. 11-12). Scanzoni recommends that less emphasis be placed on research and more on teaching undergraduates, and that faculty should be required to justify and defend their contributions to students. Universities should continue to attend to the business of education, but they should do so in ways that contribute more directly to society-at-large.

Halpern (2002) claims,

> [H]igher education needs to be redesigned. Virtually every variable in the higher education equation is changing at a rapidly accelerating rate. Change is hard, and universities do not take kindly to it ... A successful pedagogical philosophy that will serve as a basis for learning must incorporate understandings about the way in which learners acquire and organize information. This philosophy must address how students represent knowledge internally, the way they store it (that is, keep it in their minds), the way these representations change, and the way they resist change over time. (Halpern, 2002, p. 41)

Furthermore, "[M]ost professors have gained relatively little from cognitive psychology. Even cognitive psychologists apply very little about what they know about their own discipline in their own teaching" (p. 42). Halpern concludes that higher education faculty "can do a better job" (p. 43) in their "most important task": enhancing student learning.

Sterman (2001) noted (in the context of business management), "All too often, well-intentioned efforts to solve pressing problems create unanticipated side effects. Our decisions provoke unforeseen reaction. The result is *policy resistance*, the tendency for interventions to be defeated by the response of the system to the intervention itself" (p. 8, original emphasis). To Sterman, complex systems thinking provides tools to produce "sustainable benefit" in terms of reforming bad institutional policies. "For many, the solution lies in *systems thinking* – the ability to see the world as a complex system … With a holistic worldview, it is argued, we would be able to learn faster and more effectively, identify the high leverage points in systems, and avoid policy resistance" (pp. 9-10).

Hubball, Collins, and Pratt (2005) reported on an innovative faculty development program at the University of British Columbia, which was designed to provide faculty members "with a means of looking more deeply at the underlying values and assumptions that constituted their philosophical orientations to teaching" (p. 57). Faculty learned to develop critically reflective teaching practices, to think critically about curricula and about pedagogical issues, to articulate their values and beliefs, to recognize the value of inclusion and equity, to design responsive courses, facilitate active learning, and to use a variety of communication, teamwork and leadership skills. Assessment on the *Teaching Perspectives Inventory* indicated that "the various … activities did promote an expanded conceptualization of teachers' views of their professional roles … suggesting an expanded mindfulness of how and why these teachers went about their instructional duties" (p. 70). However, "For many faculty members the request to reflect critically on their teaching was an unfamiliar and daunting task … the objects and processes of critical reflection were not self-evident to our participants" (p. 75).

Cleveland-Innes and Emes (2005) have called for higher education curricula to focus on outcomes that relate to the development of competent lifelong learners. Faculty should focus on providing opportunities for students to manage their own learning; "The key identifier of a learner centered curriculum is the inclusion of outcomes related to knowledge and skill about human development" (p. 87). The authors specify three pedagogical objectives that serve this purpose: clear objectives must be specified for content mastery and skill development; students must learn about learning; and "a learner centered curriculum will offer a breadth of opportunities that demonstrate all possible mechanisms for learning, and offer 'blended' choices of curriculum delivery … In other words, higher education will accept the responsibility of developing individuals who are able to design and manage their own learning and growth" (p. 87). Thus faculty must become "well versed in the tenets of supporting learning … In addition, faculty will support increased responsibility for students, rewarding learning by increasing student control over the learning process" (pp. 101-102).

To support students in learning to manage their lives responsibly, Sternberg (2001) argues that schools should teach "for wisdom," which he describes as "the application of tacit as well as explicit knowledge as mediated by values toward the achievement of a common good through a balance among (a) intrapersonal, (b) interpersonal, and (c) extrapersonal interests, over the (a) short and (b) long terms, to achieve a balance among (a) adaptation to existing environments, (b) shaping of existing environments, and (c) selection of new environments" (Sternberg, 2001, p. 231). He points out, "An important part of analytical thinking is metacognition. Wisdom seems related to metacognition, and it is, because the metacomponents involved in wisdom are similar or identical to those that follow from other accounts of metacognition" (Sternberg, 2001, p. 233). These "metaknowledge components" comprise a particular set of skills: (a) recognize a problem, (b) define the problem, (c) gather/represent information about the problem (d) form a strategy, (e) allocate resources, (f) monitor the solution, and (g) evaluate feedback (Sternberg, 2001). Sternberg recommends that schools should teach for wisdom, because knowledge is insufficient for human satisfaction and happiness, we need to incorporate "considered and deliberate values" in our judgments, and students who benefit from learning to think wisely will be better equipped to create better communities. Sternberg provided 16 principles as bases for instruction, which include teaching independent thinking, recognizing other's interests and one's own values, balancing interests, thinking dialectically and dialogically, recognizing common good, resisting undue influences, and encouraging and rewarding wisdom.

Inferences Regarding Designing Instruction

In consideration of the above, there appears to be a growing consensus that transmission (recall and recognition) models of teaching and learning are insufficient with regard to designing instruction to support and facilitate higher-order cognitive development. Rather, new technologies and new approaches to instructional design provide means for learning communities to provide cognitive scaffolding, affective support, and a sense of belonging that encourages students to engage in their own cognitive growth. Furthermore, educators and administrators need to think critically about the quality of undergraduate education in social sciences, faculty development should be clearly oriented towards higher-order cognitive skills development, and university administrators should manage their institutions out of their original purpose (to indoctrinate students into established lore) and into a paradigm of continual and active inquiry into better means of supporting the higher cognitive development of their undergraduate cohorts.

Qualitative Research Methods

Denzin and Lincoln (2005) have described qualitative research as "a situated activity which locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible" (p. 3). By creating a series of representations (field notes, observations, recordings, etc.), we can "triangulate" our interpretations, comparing them with each other to infer consistently meaningful perspectives. "Research strategies implement and anchor paradigms in specific empirical sites or in specific methodological practices, such as making a case an object of study" (p. 25). The focus of research is placed on verisimilitude, caring, practices, and dialogues; the individual views (rich descriptions and deep details) of the participants can be synthesized into useful interpretive frameworks.

Describing some useful standards for qualitative research, Rubin (2000) wrote, "A chief strength of qualitative inquiry is the depth of understanding that it can provide. Manuscripts … should report observations and findings in a thorough manner that enables readers to gain an in-depth understanding of the phenomena being studied and that provides a compelling case for the author's interpretations" (p. 174).

Johnson (1997) speaks to considerations of the *validity* of qualitative research, which on his account concerns the production studies that are "plausible, credible, trustworthy, and, therefore, defensible" (p. 282). Researchers must avoid having their biases distort their interpretations of research data, biases which may otherwise lead them to write whatever results they want to find. A key to overcoming this obstacle is *reflexivity*, critical self-reflection that allows researchers to "monitor and attempt to control their biases" (p. 284). Another method for combating bias is *negative sampling*, the search for, and explanation of, examples that disconfirm researcher expectations. *Descriptive validity* refers to the accuracy of researchers' accounts of events, and *investigator triangulation* requires the use of multiple observers to ensure that recorded events actually occurred. *Interpretive validity* describes the accuracy of the portrayal of the meanings that participants attach to their activities and their reports; participant feedback (or *member-checking*, Lincoln & Guba, 1985) may be used to ask the participants to verify a researcher's interpretations of an interview or observation. *Theoretical validity* refers to "the degree that a theoretical explanation fit the data and, therefore, is credible and defensible" (p. 286).

Methods Used in Field Research

Babbie (1999) points out that field research is appropriate for studying attitudes and behaviours in their natural settings. "One of the key strengths of field research is the comprehensiveness of perspective it gives researchers. By going directly to the social phenomenon under study and investigating it as completely as possible, they can develop a deeper and fuller understanding of it" (p. 262).

Brenner, Brown and Canter (1985) note that interviews provide unique opportunities for researchers and participants to understand each other, since surveys do not allow for participants to inquire into the meanings of questions, nor for researchers to request clarifications of responses. However, Dilley (2000) wrote that, although few instructors of courses in qualitative methods focus much attention on the act of interviewing, "Good interviewing … opens new voices, new vistas, new visions …" (p. 136). Babbie (1999) also emphasizes the importance of qualitative interviews in eliciting information from participants, noting, "Interviewing needs to be an integral part of [the] field research process" (p. 270). Tierney and Dilley (2002) note, "Qualitative interviewing can be used to gain information that cannot be obtained using other methods … Surveys … lack the depth of understanding that a qualitative interview provides" (p. 454). The point is to understand not only the events that occur, but also the personal contexts in which they unfold; teachers may be a rich source of material on pedagogical practices, sharing their experience of what works in the classroom. "[R]ather than assuming that policy analysts or school principals can define the educational context, researchers now focus in their interviews on understanding [teachers'] interpretations of reality" (Tierney and Dilley, 2002, p. 459). Students are also legitimate sources of pedagogical data, and there has been a "movement to include the voices of those being educated in the learning process …. educational researchers have revised their research designs to include those who actually experience the educational process…" (Tierney, and Dilley, 2002, pp. 458-459). The interview experience may even be empowering to the participants since "We expect that researchers with critical predilections will …

attempt to foster interview respondents' abilities to alter their personal or educational situations if they wish to do so" (Tierney, and Dilley, 2002, p. 466).

Creswell (2002) describes *grounded theory design* as "a systematic, qualitative procedure used to generate a theory that explains, at a broad conceptual level, a process, an action, or interaction about a substantive topic … A 'process theory' explains an educational process of events, activities, actions and interactions that occur over time (p. 439). Strauss and Corbin (1998) describe the steps in grounded theory research as labelling the portions of data that are relevant to the inquiry (*open coding*), relating the categories to various sub-categories (*axial coding*, which entails "linking categories at the level of properties and dimensions," p. 123), and *selective coding,* "the process of integrating and refining the theory" (p. 143). The purpose is to produce a set of interrelated concepts, reducing the data "from many cases into concepts and sets of relational statements that can be used to explain, in a general sense, what is going on … The essential element is that categories are interrelated into a larger theoretical scheme" (pp. 145-146).

Creswell (2002) defines a *case study* as "an in-depth exploration of a bounded system (e.g. an activity, event, process or individuals) based on extensive data collection" (p. 485), and a *collective case study* (or *multiple instrumental case study*) as research in which "multiple cases are described and compared to provide insight into an issue" (p. 485). Analyses of case studies may use description and thematic analysis to interpret observational and interview data; cases are located within a larger context that frames the purpose of the study.

Hicks (1994) describes *analytic induction* (AI) as "an inductive specification of a general theoretical framework" (p. 86). Attributed to Robinson (1951), "classical" AI recommended the use of hypotheses as a "gateway to a process of theory-building rather than as a fixed target in a one-shot test" (Hicks, 1994, p. 88). The emphasis is on negative sampling and negative case analysis, where disconfirming evidence is sought that demonstrates weaknesses in a hypothesis; hypotheses are reformulated when necessary to provide insightful descriptions of social processes. Denzin (1989) points out that AI "provides a method by which old theories can be revised and incorporated into new theories … [and it] forces a close articulation between fact, observation, concept, proposition and theory" (p. 169). It also "leads to developmental or processual theories, and these are superior to static formulations … Sociologists need theories and models of proof and inference that interpret social process" (pp. 169-170).

Inferences Regarding Pedagogies of Higher-Order Thinking

The literature on qualitative research indicates that qualitative designs are suitable for observing and describing distinctions between poor and excellent instructional environments/interventions, and that teachers and students can collaborate with researchers to produce research data that provides insight into pedagogical practices associated with higher cognitive development.

What's Missing?

A great deal of quantitative educational research has been dedicated to examining the effectiveness of educational interventions with regard to facilitating cognitive development; however, analyses of statistical relationships of specific independent variables with outcome measures provide little insight into *how* educational processes actually work (or fail to work) in various educational contexts. Few qualitative studies have apparently been undertaken to illustrate the experiences of teachers and learners – what they are prepared (or unprepared) to do, what works or doesn't work according to the experiences of those involved, and how learning (or failure to learn) affects individual students. To gain insights into what works well (or does not work well), and to understand *how* teaching and learning operate with regard to facilitating higher cognitive development, we need to inquire further into the pedagogical processes involved to see not only what interventions were applied, but how they were applied, which aspects of the processes were most and least helpful, and how the processes affected the participants. Quantitative measures are ill-suited to provide insights into these questions; observations and interviews can provide qualitative data to illuminate the effectiveness of educational processes according to the experiences of those who are actually involved.

I therefore decided (with the encouragement of my faculty advisors) to engage in two qualitative research studies to investigate how education students have been educated in learning and teaching with regard to developing higher-order thinking. I interviewed education instructors across Canada to inquire into their practices; I also conducted a collective case study of several education classes at one university.

3. Study 1

Method

Interviews

Qualitative data were obtained through semistructured interviews from a purposive sample of post-secondary education instructors at large Canadian universities from coast to coast. Participants were selected according to their positions as instructors of education courses that address cognition. I used university worldwide web sites to identify individuals who had taught courses during the Winter 2007 term, in one of the following areas: educational psychology, educational philosophy, or principles of learning and teaching. I sent fifty-seven letters of invitation by email to thirteen universities in the first week of May 2007, explaining that the purpose of the study is to explore education programs in Canada with particular attention to classes that deal with higher cognitive development.

By the end of June 14 instructors at eight universities (well distributed across the country) had agreed to be interviewed, and had sent their course syllabi to me for my information. The participants were informed of the ethical regulations for this study, which included my promise of confidentiality and their right to withdraw their participation at any time. Interviews were conducted during July and August, 2007; the respondents were encouraged during the interviews to describe their pedagogical views on teaching and learning with regard to higher order thinking (theories and practices). The following questions were posed to each participant:

What thinking skills do you consider to be of greatest importance in education?

What signs of higher-order thinking do you consider to be important?

Describe the most important considerations with regard to teaching and learning critical and higher-order thinking that affected your design of your courses this year.

What were the most remarkable results that you observed this year?

What were your biggest disappointments?

What did you learn with regard to teaching and learning about thinking, and how might what you learned affect your design or delivery of future courses?

I've studied your syllabus, and I'd like to discuss with you how you approached the following topics:

a) Critical thinking skills and critical dispositions

b) Epistemology

c) Metacognitive self-regulation and self-regulated learning

d) Transformative, emancipative and dynamic theories of learning

With the consent of the participants, all of the interviews were recorded on a digital audio recorder, and were transcribed for later analysis. I then produced a one-page summary of each interview; the summaries were sent back to the participants for checking and correction. The course syllabi and curricular materials were examined to see if there were any discrepancies between the interview data and the published course descriptions. The data were then analyzed with respect to their pedagogical relevance in terms of published educational literature on the pedagogical theories, and the practices, of post-secondary education.

Data Analysis

Fourteen instructors were interviewed, eleven by telephone and three face-to-face. The average length of an interview was 29.5 minutes; the transcripts totalled 82 pages (47,448 words). The participants were very co-operative and forthcoming during their interviews, and all of them also responded to follow-up questions. I created one-page summaries of each interview; eleven participants approved the original summaries as accurate representations of their views, and three clarified some points.

After consultation with my faculty advisors to devise a plan for the data analysis, the following procedures were carried out. Two other doctoral candidates (experienced teachers who are well versed in pedagogical theories) worked with me to corroborate the qualitative analyses of the interview data. The method of constant comparison (Strauss & Corbin, 1998; Creswell, 2002) was used; open, axial and selective coding was employed to yield conclusions about what works, in the experience of the participants, with regard to supporting and facilitating higher-order cognitive development with students of education. Grounded theory analysis was applied to discover what the participants thought about this area of their work.

With regard to topics of instruction, analytic induction (hypothesis confirmation/disconfirmation) was employed to see whether the interviewees addressed the topics that were specifically targeted for investigation.

HyperRESEARCH^{TM} software was used to assign open codes to every phrase or passage that was of pedagogical interest (with careful attention to ensure that no relevant parts of the texts were ignored or overlooked). I explained to my colleagues that the process called for the open codes to reflect the interviewees' words, and their meanings, as closely as possible. I worked together with each assistant to code one interview, discussing every passage and agreeing on every code that we assigned. After having coded one interview together with each assistant, I observed them as they each coded another interview, and we then discussed all of those codes until we agreed on all of them. After that, each assistant observed me coding an interview, and all the codes were again discussed until agreement was reached on every one. After six interviews had been completed in this fashion (and every passage, and every code, had been agreed by two reviewers), I coded the last eight interviews and submitted all of the codes and the source texts to my teammates, who examined them closely and made notes of questions or disagreements (which we resolved in a subsequent meeting).

To begin the second phase of data analysis ("axial coding"), I downloaded the open codes and source texts from HyperRESEARCH^{TM}, and I used Excel^{TM} to label the codes according to common themes (categories). I listed all of the open codes interview by interview, and I sorted the codes for each interview to broad categories. Then I created diagrams that showed all of the open codes for each interview, category by category, and I inserted links in the diagrams to denote connections and interactions.

I performed the final axial coding (identifying sub-categories) by re-examining all the open codes, category by category, and (wherever necessary) examining their contexts in each interview. I then divided the categories into sub-categories (and further divided the sub-categories into more specific items). I presented the results of these tentative analyses to my coworkers, who each took half of the codes and examined each categorization. We discussed all discrepancies between our ideas on this process, and we finally agreed on categories, sub-categories, and finer distinctions that reflected each open code according to the contexts of those codes in their respective interviews.

Results

Interviews

Summaries of the 14 interviews are presented in Appendix A. Table 3 describes (in brief) the fourteen courses that were investigated. The instructors' teaching experience ranged from five to thirty-nine years. Thirteen of the fourteen had ten or more years of experience; at least eight had twenty years or more in teaching. There were five classes in educational psychology, three in philosophy of education, and six others, which covered various principles of teaching and learning. The courses had approximately 875 students in total.

The summaries of the fourteen interviews are presented in Appendix A.

Table 3. Participants, classes, and students

Instructor	Subject	Teaching Experience	Class size	Course Duration	Mostly preservice teachers?
Instructor 1	Educational Psychology	10 years	~240	1 semester	No (very few)
Instructor 2	Critical Pedagogy	5 years	~30	1/2 semester	Yes (all)
Instructor 3	Principles of Teaching	13 years	~36	1 semester	Yes (all)
Instructor 4	Educational Psychology	35 years	30-35	1 semester	Yes (all)
Instructor 5	Educational Psychology	24 years	~40	1 semester	Yes (all)
Instructor 6	Educational Psychology	20 years	~90	1 semester	Yes (all)
Instructor 7	Educational Psychology	16 years	~50	2 semesters	Yes
Instructor 8	Educational Philosophy	16 years	~50	1 semester	Yes
Instructor 9	Principles of Teaching	39 years	~35	1 semester	Yes (all)
Instructor 10	Educational Philosophy	35 years	~70	1 semester	Yes (about 70%)
Instructor 11	Principles of Teaching	27 years	~35	1 semester	Yes (all)
Instructor 12	Teaching History	20 years	~35	2 semesters	Yes (all)
Instructor 13	Teaching Science	27 years	~30	1 semester	Yes (all)
Instructor 14	Educational Philosophy	39 years	~100	1 semester	Yes

Most of the students were preservice teachers; while Instructor 1 did not teach many preservice teachers, I decided that this fact was not ultimately relevant to the aim of investigating the contents, methods, and results of education courses, so these interview data were included in the analyses.

Categories

Nine hundred ninety-one open codes were assigned to the fourteen interviews. Initial axial classifications of the open codes (with reference to the contexts described in their respective source transcripts, and with regard to their pedagogical interest) resulted in the emergence of six broad categories (themes) of interest, all of which were represented by data from all fourteen interviews. Topics of instruction were specifically targeted for investigation; aside from this category, five other classes of material emerged according to their pedagogical relevance: learning objectives, methods of instruction, challenges, outcomes, and instructor's positions. Table 4 provides definitions for these categories, as they were ultimately applied in this process of classification. Eliminating the duplication of open codes in any single interview (and discarding a half dozen which were eventually deemed irrelevant) ultimately resulted in eight hundred three open codes in the six categories. The codes were then assessed for the purpose of sub-categorization, to allow for finer-grained analysis of the interviews. The following sections, and the Discussion below, present my syntheses of the results from all of the interviews.

Table 4. Categories of open codes and their description. Numbers in brackets represent the total number of codes assigned in each category

Topics (71)	Course content on higher order thinking; subject matter specifically presented by the instructor
Objectives (206)	Learning objectives with regard to cognitive performance
Methods (155)	Teaching and learning methods used in the course under consideration and described during the interviews.
Challenges (134)	Problems, obstacles or difficulties that present barriers to teaching and learning with regard to higher order thinking
Outcomes (91)	Specific results (achievement or satisfaction)
Positions (146)	Instructor's ideas, beliefs or opinions about the processes of teaching and learning with regard to higher order thinking

The tables in the sections that follow present all the sub-categories, and the further divisions of the sub-categories, that were specified by more than one interviewee.

Topics

Instructors were specifically asked about five particular subject-matter areas (critical thinking, critical dispositions, metacognitive self-regulation, epistemology and transformative or emancipative learning); a number of other topics of instruction were also mentioned during the interviews.

Table 5 depicts the sub-categories of the Topics category; these represent subject matter areas that were presented in the courses. The number of participants who included these subjects in their courses (maximum of fourteen) is represented by the frequency statistic in this table and all of the tables that follow. Table 3 also presents the specific topics within the four major sub-categories.

The number of topics mentioned by the participants ranged from three to six. Two respondents mentioned six topics: Instructor 13 (science education) covered all of the topics being directly investigated in this study, including aspects of thinking skills, critical dispositions, epistemology, philosophy of science, self-directed learning and transformative learning. Instructor 1 (teaching educational psychology) talked about critical thinking, epistemology, metacognition, ontology, philosophy of science and emancipative learning.

Table 5. Topics: Sub-categories with associated topics; frequencies are in parentheses (maximum fourteen)

Sub-Category	Topic
philosophy (10)	epistemology (9) philosophy of science (2)
thinking skills (10)	metacognition (6) critical thinking (4)
self-regulation (9)	
dispositions (7)	critical dispositions (4) habits of mind (2)
transformative learning (4)	
emancipative learning (2)	
problems and problem solving (2)	

Nine respondents reported that they discussed aspects of epistemology, however, only two of them had included this topic in their syllabi (one as a supplementary reading, and one as a term of interest), and only one of them (Instructor 10) claimed to have addressed the topic other than superficially. Transformative and emancipative learning were seen as distinct by four of the interviewees who treated these topics; only Instructor 2 introduced both these theories in the classroom.

Six participants (including four of the five educational psychologists) talked about metacognition, while nine discussed self-regulation, only one of which (Instructor 3) emphasized the subject of self-correction. Reflecting on these numbers, I can only echo the sentiments of Instructor 12, who shared, "I wish that more teachers were in this [teaching thinking skills]." It may be that many (and perhaps most) education students could benefit from instruction, and practice, in self-monitoring, self-evaluation and self-correction.

Eight instructors included critical dispositions as course material.

On the subject of self-transformation, it is also apparent that transformative and emancipative theories of learning (while propounded by some instructors) are not at the centre of the pedagogical mainstream; a minority of the respondents acknowledged the potential value of understanding these ways of thinking about learning.

Instructors 1 and 13 included work on the philosophy of science (which is related to epistemology, the philosophy of knowledge and knowing) as a means of promoting higher order thinking. With regard to epistemology, only one educational philosopher claimed to have delivered substantive instruction in the subject (while eight others said that they mentioned it, but briefly).

Objectives

The instructors described many and various learning objectives; the sub-categories and the specific objectives are shown in Table 6.

Table 6. Objectives: major sub-categories, specific learning objectives and frequencies

Sub-Category	Objective
reasoning (14)	analysis (9)
	synthesis (9)
	critical thinking skills (7)
	coherence (5)
	argument skill (4)s
	challenging (4)
	problems (4)
	justification (3)
	discipline-specific (2)
understanding (11)	other people (6)
	higher order thinking (5)
	material (5)
	procedures (3)
	teaching (2)
metacognition (11)	reflection (10)
	self-evaluation (3)
dispositions (9)	openness (5)
	responsibility (3)
teaching skills (9)	applications (9)
inquiry skills (8)	asking good questions (7)
creativity (4)	creative thinking (2)
motivation (3)	encourage students to transform society (2)
socialization (3)	collaboration (2)
self-transformation (2)	

All of the instructors intended that their students improve their reasoning faculties; analysis, synthesis, and critical thinking skills were emphasized by at least half of the respondents. Understanding the course materials, and understanding peoples' thinking, were also deemed to be important learning goals. With regard to metacognition, ten participants wanted their students to reflect on their thinking and learning, while three emphasized the need for self-evaluation. Nobody mentioned self-correction as an educational objective (but two referred to cognitive transformation, a related goal).

Twelve sorts of dispositions were related to higher order thinking by nine instructors; five described the value of openness (or open-mindedness), and three mentioned personal responsibility for thinking and learning as a key goal. Teaching skills were important objectives for nine instructors, and seven referred to the value of learning to ask good questions.

Only Instructor 7 called for self-understanding as a learning goal (although again, "reflection" may be said to include this process). It seems that calling for students to "reflect" is important to many of the respondents, but what are they asking their students to accomplish through reflection? Examination of the syllabi and course materials indicates that some of the instructors gave specific instructions on the self-regulatory purpose of reflecting, while others did not. Instructor 13's syllabus directed the students to consider the following questions: "What have you learned about your development as a science teacher? How have some of your preconceptions and ideas about science and science teaching changed over the course? Why? How will this influence what you do in the classroom?" In contrast, Instructor 1's instructions for the reflective writing assignments were to consider one's reflections on a subject, then to take a position and defend it (present evidence and reasoned arguments). Guided reflection, and a clear understanding of the benefits of self-evaluation and self-correction, may be fundamental to higher order learning.

Half of the instructors set the development of critical inquiry skills as an educational objective, and the call for critical dispositions is far from unanimous. This leaves me wondering how strongly the respondents have emphasized the importance of psychological attitudes with regard to achievement motivation. Curiosity, and perseverance in one's commitment to learning, should be recognized as central to the context of cognitive development. Only five respondents called for open-mindedness, and references to other critical dispositions were scattered. With regard to preparation (or lack thereof) for learning higher order thinking, appropriate psychological commitments to fluency, coherency and justification are necessary if there is to be any possibility of achievement in this area of self-development.

It appears that a wide variety of learning goals may coherently be associated with higher cognitive development, and that the participants in this study are quite clear about what they want their students to accomplish. However, the interviews indicated that there was more than a little difficulty in supporting the students in overcoming their various problems with the educational processes involved; also, the reported objectives are widely distributed amongst the participants, and (after examining the details of the sub-categories) only four objectives were shared by more than half of the instructors.

Methods

Table 7 lists the instructional methods that were described during the interviews as being useful for teaching and learning higher order cognitive processes.

Table 7. Methods: major sub-categories, specific methods and frequencies

Sub-Category	Method
discussion (11)	small group (7) large group (4) engagement (2)
assignments (9)	reflective writing (6) demonstrate thinking (4) demanding readings (2) student projects (2)
stimulate thinking (9)	ask questions (5) provoke thinking and questioning (3)
analysis (7)	analyze learning (3) analyze methods (2)
A/V technology (6)	
assess thinking (4)	
challenge thinking (4)	
co-operative activities (4)	
exercises (4)	
compare and contrast (3)	
role play (3)	
safe environment (3)	
variety (3)	
argument (2)	
case-centred approach (2)	
creative writing (2)	
demonstration (2)	
evaluation (2)	
individual coaching (2)	
meaningful examples (2)	
narratives (2)	
Internet use (2)	

Small or large group discussions were emphasized by eleven instructors; course assignments, and methods of stimulating thinking during class sessions, were each described by nine participants. The working through of various types of analyses was employed in seven courses, and six instructors used film or video clips to illustrate their material.

There was no mention of educational technology (aside from A/V equipment) being used in the classes under investigation, and this was a surprising result; while I had no expectation of learning that these instructors were using simulation software or virtual reality systems to facilitate engagement with complex problems, I learned that asynchronous discussion forums were not used by any of the respondents as a tool to facilitate collaborative engagement in progressive discourses. Examination of the course syllabi confirmed that none of the courses that I studied employed this method.

Challenges

Table 8 presents the various difficulties that were encountered by the participants in their efforts to facilitate their students' cognitive performance.

Table 8. Obstacles: major sub-categories, specific challenges and frequencies

student barriers (14)	unprepared for higher-order thinking (10) students' reluctance/resistance (8) students' preconceptions (8) students lack interest in higher order thinking (6) students desire structure (5) lack of prior knowledge or experience (4) lack of basic skills (4) students' bad habits (4) variability in students' preparedness (3) lack of confidence (2) learning styles (2) students' difficulties with material (2) students' expectations (2) variability in student competencies (2) weak writing skills (2)
institutional constraints (12)	lack of time (8) large classes (5) restrictive curricula (4) failure of secondary schools (3) lack of appropriate texts (2)
challenging task (3)	difficult to teach thinking (3)

All fourteen respondents pointed out their students' difficulties, barriers or problems with regard to understanding and developing higher order cognitive processes. Many of the students were reportedly unprepared for, or uninterested in, this sort of work, and two instructors acknowledged that the secondary schools have done an inadequate job in preparing the students to engage in the efforts required to develop higher order thinking. Many students were reluctant to engage (Instructor 6 claimed that his class was actually "passive-aggressive," and strongly resistant to his ministrations); many lacked basic fluency skills, and were (accordingly) also lacking in confidence. Large classes were also described as being inimical to the process of teaching, learning and practicing higher order cognitive tasks.

Instructor 13 pointed out a particular preconception that was shared by most of the students, remarking, "There seems to be kind of a naïve realist understanding of the nature of science." This statement might point to one of the greatest problems related to learning to think coherently: low epistemological sophistication. Many (and perhaps most) education students (like most other people of my acquaintance) are unaware of the usefulness of applying coherentist and non-foundational philosophical paradigms to the analysis of human understanding, as opposed to the more popular (but less sophisticated) foundationalist approach, which relies on the correspondence theory of absolute truth. Students who learn the distinction between low epistemological sophistication (relying on authoritative sources for true statements) and high sophistication (interpreting statements according to local and contingent standards of justification) may be in a better position to adopt the dispositions, and to do the self-regulatory thinking, that eventually leads to broadly and deeply justified conceptual schemata. As Siegel (2006) pointed out, epistemological issues can only be grasped when proper educational training is applied.

Outcomes

Table 9 lists various outcomes reported by the interviewees.

Table 9. Outcomes: major sub-categories, specific results and frequencies

Sub-Category	Outcomes
favourable (13)	successful learning (7)
	changed perspectives (6)
	enthusiasm (6)
	creative efforts (2)
	instructor encouraged (2)
	peer support (2)
	wanting more (2)
unfavourable (9)	failure to learn (9)
	instructor discouraged (2)
	unprepared to teach thinking (2)
variable (4)	variable outcomes (4)

While half of the respondents reported some successful results of teaching and learning higher order thinking, more than half of them shared that many of their students did not manage to learn to improve their cognitive processes very much. Others pointed out a wide variability in their students' cognitive outcomes.

When asked about the (remarkable or disappointing) results that they had seen, four instructors specifically remarked on the variability of outcomes; six produced both favourable and unfavourable reports, and four shared only favourable results (including Instructor 11, whose only reported result was the fact that students sometimes called back months or years after completing the course to ask for some more information; and Instructor 2, who said that the students "worked hard," and increased their self-awareness).

While a few instances of transformational moments of learning (breakthroughs in understanding) were reported, this type of result was exceptional, rather than common.

Instructor 2 provided a very poignant passage, which underlines a concern for the education of future generations of students, saying,

> [S]tudents are largely coming from a place where they have chosen, maybe subconsciously, to just repeat, in their teaching practice, a lot of the things that they were taught themselves by their teachers. It's … it could be a vicious cycle … If students don't realize themselves through self-reflection, where they are coming from themselves, what kind of thinking that they're engaged in, the value of higher-order thinking, the less inclined they are to be engaging their students with an awareness of those issues. So my perspective is that we need to be talking about awareness issues, talking about options, talking about the ramifications of not doing anything … [J]ust following along in the same ways many have done for a long time, is dangerous.

Positions

Table 10 shows the perspectives that were articulated by more than one participant during our conversations.

Table 10. Instructor positions: major sub-categories, specific ideas and frequencies

Sub-Category	Position
Thinking skills (12)	value of higher order thinking (6) value of teaching thinking (4) critical thinking skills can't be taught (2) need to understand types of thinking (2)
course design (10)	rethinking course design (8) avoid mere transmission of ideas (2) constructivist approach (2) current sources (2) history of ideas (2) importance of discourse (2) learning community (2) student centred works best (2) students need standards, goals (2) variety of sources of knowledge (2)
student traits (10)	some students interested in thinking (4) variability of student competencies/interests (3)
value of experience (9)	learning comes from experience (9)
schools (4)	universities don't emphasize thinking (2)

The results indicate a wide variety of views that were shared by the instructors; there is not a great deal of consensus that is evident here. However, six remarked that higher order thinking is important with regard to educating educators, and four pointed out the value of addressing this topic in the classroom. Aside from the positions shown in Table 8, there were about seventy other pedagogical views that were coded, each of which was shared by one participant. To list a few: Critical thinking is not taught very much in schools, education curricula should require students to learn philosophy of science, more teachers should teach thinking skills, instructors must motivate their students, and the social challenges of the future will require better thinking skills than are currently being taught in schools. One participant was satisfied with the students' level of preparation for higher order learning (an exceptional class, perhaps; or maybe this instructor had lower expectations than others).

One instructor said that the course was designed with teaching thinking skills as a focus of instruction; another specifically said that the course was not designed to teach thinking. One said that thinking skills arise from apprenticeship, passion, and deep immersion, and one averred that thinking skills develop from reading.

As mentioned in the Topics section above, two instructors were antithetical to the idea that thinking skills should, or even could, be taught. While this notion accords with the philosophical position promoted by McPeck (1981), it was promulgated by a minority of the respondents; other participants were enthusiastically in favour of the idea that higher cognitive skills can and should be facilitated in the classroom (and beyond).

Findings

Prima Facie Impressions

Seven of the respondents (Instructors 2, 3, 5, 7, 9, 12 and 13) were quite strongly convinced (and some were very enthusiastic) about the value of teaching thinking skills in their classes. On the other hand, three instructors (Instructors 1, 4 and 10) seemed very doubtful (and two were quite antagonistic to the idea) that the subject is relevant to their students' learning in their classes. As Instructor 10 described one point of view, "[T]alking in terms of 'the thinking skills' is a bad thing to do. I think that the model of skills is inappropriate for the mind." The other four instructors covered some aspects of the cognitive processes in their classes, but put little emphasis on the value of understanding these processes in detail.

Upon initial examination of the results of the data analysis, it was apparent that a very wide variety of pedagogies and teaching methods were cited as being relevant to the teaching and learning of higher order thinking processes. The instructors, in general, have had many years of experience in their business, and I was struck by the fact that they held such divergent (and sometimes contradictory) views about the theories and practices associated with promoting cognitive development. In particular, I noticed that several of the participants were either lukewarm, or downright antagonistic, to the idea that time should be spent introducing their students to the language of cognitive psychology, critical thinking, and metacognition; while some are strongly convinced that these are very important subjects for education students, others are equally adamant in their conviction that discussions of thinking skills are largely irrelevant to their practices. Resistance to the notion that thinking skills can be taught (as exemplified by McPeck, 1981) is inauspicious with regard to the implementation of pedagogies that promote the understanding of cognitive processes.

Secondly, the cognitive performance learning objectives described by the instructors were also quite numerous, and (in general) seem to be appropriate with regard to the work being investigated here. All the respondents want their students to improve their reasoning processes; more than half specified the importance of analyzing and synthesizing materials and ideas; half specified the need to work on thinking skills, and some encouraged their students to think coherently or to argue competently. Others specified problem resolution, challenging accepted views, and asking good questions as learning goals. Understanding thinking, understanding course materials, and understanding their students were also seen as important, as was learning to reflect on one's own learning and understanding. Improving teaching practices was also an important goal for nine of the instructors.

A third result was also clearly evident: all of the topics under investigation in the analytic induction phase of this research were included in their courses by at least some of the instructors; this is to say that all five subject areas under investigation (critical thinking, critical dispositions, metacognition, epistemology, and transformative/emancipatory learning) were seen as useful course content by some Instructors of education. Although this is an encouraging result (from my perspective), only one participant (Instructor 13) covered all five topics in the framework I have proposed, and one (Instructor 1) discussed four of the five (omitting details about critical dispositions).

A fourth point of interest is the long list of challenges encountered in supporting and facilitating students' development of higher order cognitive processes. It seems that the intention to teach students to improve their attitudes towards learning, and to develop their cognitive and metacognitive proce5sses, is countered by many prevailing forces (including prior histories and individual commitments);it may be important for educators to focus on these difficulties (if they are ever to be overcome).

Finally, it seems that (while some encouraging outcomes were reported) the reported results of teaching higher order thinking have been highly variable, and quite discouraging in many cases.

It would be an exaggeration to claim that most of the undergraduate students described in the interviews were very well trained, or well skilled, in higher order thinking. This led me to wonder whether the paradigmatic conflicts between educators, with regard to their theories of education and their pedagogical practices, may have interfered with the development of effective responses to the challenges that are faced by the purveyors of higher education.

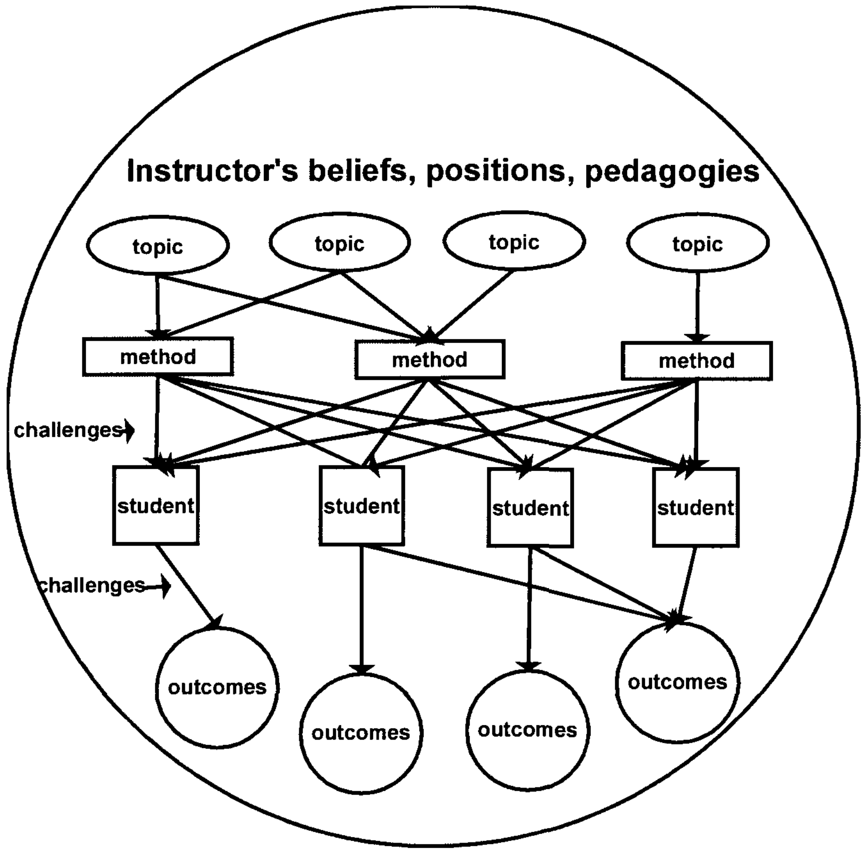
Selective Coding

According to Strauss and Corbin (1998), "selective coding" is "the process of integrating and refining categories" (p. 143) in order to provide a coherent theoretical explanation of the results of the data analysis using the grounded theory method. This requires the specification of a central category that relates to all other categories, and the development of a theoretical explanation to illuminate the reported occurrences.

Figure 2 depicts the relationships between the categories. The instructor creates the course (before the students arrive, and co-creates the outcomes along with the students; thus the instructors ideas permeate the educational space, and they form the context within which all educational and assessment activities occur (including selection of topics, methods and objectives, as well as specific assessment criteria). The topics are manifested through different methods; one topic may be associated with a single method, or with several, and some methods may be used for several topics. While all students (in most cases) are presumed to have equal access to all methods, students may limit their attention according to their individual preferences. The outcomes are produced the students (several of whom, in group projects, may share a single result).

Challenges are operative throughout the educational and the assessment processes; delivering the material can present difficulties for the instructor, and receiving the material can be problematic for the students. In addition, students face various challenges in dealing with the material and with producing the desired result.

Figure 2. Relationships between categories



The results seem to indicate that all of the topics under investigation were covered in the classes given by this sample of instructors, through a variety of (seemingly appropriate) methods; it also appears that the many objectives revealed here are indeed related to the theoretical bases for higher-order cognitive development. Given this situation, and given the mixed results achieved in these endeavours, it seems appropriate to focus on the challenges to teaching and learning which were encountered by these participants. The most relevant questions seem to relate to why some students succeed so well, while others fail, and this inquiry addresses individual students' motives, interests and performance. What individual factors facilitate, or hinder, student success in learning to create complex and coherent systems of ideas? What are the main challenges that instructors face in this process, and how can they be overcome?

The following sections, which address each category of interest that was described by the participants, use the results of the interviews as the basis of a set of theoretical speculations with regard to the reported phenomena.

Topics

The results of this study show that the topics under consideration here are indeed receiving notice from some instructors; the question to be debated is whether applying more of these types of instruction would facilitate our desired educational outcomes.

In particular, relatively little attention was paid to epistemology. Given the attention paid to the construct of epistemological sophistication in the education literature, it seems likely that instruction in the understanding of human knowledge can be of great benefit to education students. Of course, it may be argued that it cannot be every education Instructor's responsibility to teach epistemology, or that those who aren't educational philosophers should not concern themselves with such matters. However, if an education Instructor is continually engaged in authoritative knowledge regimes, and doesn't indicate that alternative epistemological views may usefully be applied, then it is unlikely that that instructor will inspire many students to discover the utility of contemporary philosophical approaches during their undergraduate careers

One challenge to teaching higher cognitive development, therefore, relates to the inclusion of the various related topics in any particular education program. While it is unlikely that any instructor will spend a great deal of time covering all of the relevant subjects, it seems appropriate that each of them should be aware of the values of exploring epistemology, of defining and describing thinking skills and dispositions, of using active metacognitive self-regulation, and of transforming our perspectives through emancipative and dynamic learning. A consensus of instructors who agree on the bases for higher-order thinking and learning might be a powerful influence on the commitments of students who are interested in developing wide dynamic reflective equilibria that will enable them to produce complex sets of coherent ideas. Bereiter's (2002) reference to the importance of understanding knowing, and Rawls' (1999) description of dynamic conceptual equilibrium, provides an important starting point for the possibility of understanding, creating, and maintaining complex, yet coherent, ideational frameworks.

Objectives

The learning objectives set by these instructors seem generally to be appropriate with regard to facilitating students' cognitive development. The results indicate several points of interest, especially with regard to some goals that appeared infrequently in the results. For example., thinking hypothetically was mentioned by only one participant, and another called for "thinking outside of the box." Hypothesizing situations that are different from our familiar schemes may be an essential part of higher learning.

Metacognitive self-evaluation, a self-regulatory skill, is highly relevant to the development of coherent arguments; however, this process was specifically described as a learning goal by only three instructors, and nobody specified self-correction as an objective (although, to be fair, "reflection" may be understood to include both of these keys to higher order thinking and learning). This topic may deserve much more attention in education courses that it has received to date.

The observation that the topics were widely distributed among the courses may indicate that many of the goals, and the work to be done in attaining them, were not completely familiar to all of the students. Taken as a collection, the goals are clearly worthwhile, and if all education students were familiar with all of them, and committed to their attainment, then it seems likely that the instructors' jobs would be much easier.

Methods

The methods described are clearly well suited for the purpose of facilitating cognitive development. Discourse and argument, reflective writing, authentic problem situations and role-playing games seem to be particularly apt for this purpose; analyzing and comparing theories and methods, audiovisual demonstrations, and challenging exercises are clearly useful, and the value of individual coaching is widely recognized.

It is possible that even the best of methods may not produce optimal results, despite the best efforts of the instructors who are involved. If this is the case, then overcoming the difficulties encountered in teaching and learning processes may require deep, and long-term, interventions, including curricular reform and professional development at all levels of education. Students should (somehow) be prepared for, and initiated into, critical analysis, the careful evaluation of evidence, judging the relevance of justificatory arguments, and forming broadly coherent conclusions. The processes of higher order thinking, the dispositions associated with high-level cognitive functionality, and the practices associated with metacognitive self-regulation, can only occur in environments where the value of these constructs is recognized, and is promoted through pedagogical action.

Challenges

According to the instructors I interviewed, their students were generally not very well prepared for training in complex cognition and the processes associated with higher order justification, metacognitive self-regulation, critical dispositions, epistemological principles, or transformative and emancipatory learning. Furthermore (according to the respondents) many were reluctant, or downright resistant, to engaging in the pedagogical practices that relate to these subjects. Besides, it is very difficult work, the students were not expecting these types of challenges, and there is not enough course time to produce many successful results with regard to breakthroughs in learning to think. This complex of problems represents a daunting challenge to educators of the future.

Mezirow (1991) warned that transformational thinking presents a difficult challenge to adult learners, since, "These challenges are painful; they often call into question deeply held personal values and threaten our very sense of self" (p. 168). Psychological resistance to change can result in active resistance to learning, and teachers must learn to deal with, and to overcome, student barriers to learning how to think deeply and coherently.

Brookfield (1995) elucidates his own experiences of being a reflective practitioner, describing the process for those who recognize the importance of continually adapting to the contingencies of teaching and learning situations. "Critically reflective teaching happens when we identify and scrutinize the assumptions that undergird how we work. The most effective way to become aware of these assumptions is to view our practices from different perspectives" (Brookfield, 1995, pp. xii-xiii).

It seems that education instructors, in defining their roles of educators, cannot always concentrate on the need to ensure that their students learn every available idea that will support their higher-order cognitive development. Some may not feel that this is their main purpose; preparing pre-service teachers for their careers involves training them to teach, and higher-order deliberation may not be seen as a pre-requisite for their jobs. Concentrating on higher-order cognition takes time away from developing specific teaching skills, and (as the results have shown) it is not the easiest thing for instructors to manage.

Perhaps the greatest problem that faces educators, in their commitment to support and facilitate their students' cognitive work, is the failure of many instructors, and many institutions, to emphasize to their students, and to the community at large, that thinking skills, inquiry skills, and problem-solving skills are extremely important educational objectives. In the rush to learn the material, to remember the information, to get the grades, and to graduate, educational assessment (at the elementary and secondary levels) is hardly related to the sorts of cognitive performance that enable leaps of academic development, and, as was suggested by some interviewees, university faculties may be more involved with the business of education than with its outcomes.

Outcomes

As Instructor 2 said, "It's … it could be a vicious cycle [J]ust following along in the same ways many have done for a long time, is dangerous." Educational reform that supports the persistence of naïve philosophical realism, and which perpetuates linear styles of thinking based on authoritative knowledge, is not the type of reform that will facilitate optimal cognitive performance or the matriculation of graduates who will be well equipped to deal with the complex social problems that we face now, and will likely face in the future. This points to the lack of information that is currently available with regard to the capabilities of university graduates in general, and of newly qualified primary and secondary school teachers in particular.

To discover the qualities of the outcomes of education programs with regard to the practices of complex and critical cognition, we would need to execute a great deal of empirical research (both qualitative and quantitative) before we could evaluate the cognitive capabilities of graduating students. If we were to understand the levels of critical analysis that these students produce, the metacognitive strategies that they use, their critical dispositions, their levels of epistemic sophistication, and their understandings of critical, emancipative and transformative pedagogies, then we could design programs to improve our curricula (and train our Instructors) in order to ameliorate the outcomes. If there are no consensuses amongst the people who run our schools that teaching higher order thinking is an educational priority, then it is unlikely that we will see much research into these matters, or that we will do much to improve the results of our education programs in the area of cognitive performance.

Positions

As I discussed in the Results section above, the respondents asserted a remarkable variety of pedagogical positions (many more than can be discussed here). There were more than a few contradictions in evidence, and negative case analysis revealed that a minority of instructors rejected the idea that thinking skills should be considered for pedagogical purposes. These results were not surprising, given the controversy on this point in the education literature.

Is it possible that the diversity of professional approaches, and the contradictions between the academic commitments of experienced instructors is itself an obstacle to education? I began to speculate how new undergraduate students must react to the tremendous wealth of academic products proffered to them, and to the various perspectives that are routinely presented as alternative approaches to every topic. For most, some confusion (and perhaps a great deal of perplexity) must result from confronting this academic cornucopia, and discriminating the qualities of the fruits of their Instructors' labours must be quite difficult indeed. They are likely (eventually) to be enrolled into the widest of consensuses with regard to academic and pedagogical priorities. Learning how to learn at university must be a shock (difficult as it is for me to remember my own ancient history, I do recall some disorientation), and their instructors' (including their academic advisors') recommendations must bear a great deal of weight. If the instructors don't agree on what is important, then their students are probably unlikely to form consensuses with regard to what they are committed to learning.

This is all to say that (in my experience, and supported by the data reported here) no strong consensus on the importance of higher order cognitive and metacognitive goals, thinking skills, and thinking skills instruction has been inculcated throughout our educational systems. The consequences of the paradigm wars include a glacial rate of pedagogical progress in the development of higher order thinking skills. Contemporary research in epistemology, educational philosophy, and psychological self-regulation has not yet been appreciated to the point where all educators are aware of the utility (purported by some theorists, and propounded by some practitioners) of their pedagogical applications.

Synthesis

Upon analysis of the findings presented above, it is possible to represent an emerging picture of the pedagogical processes described by the 14 instructors who participated in Study 1. While the information from these interviews does not provide many details of classroom events or students' practices (and measurements of academic outcomes were not obtained), nevertheless the educators' rich accounts of their experiences provide some useful insights into how they have approached learning and teaching for higher cognitive development, and what came of their efforts.

Half of the respondents focused a significant amount of pedagogical energy on the teaching and learning of general thinking skills, and half did not. This finding indicates that the pedagogical commitment to this objective varied widely between the participants; this is consistent with my own experience of 17 years of post-secondary education, and it indicates that only some instructors are willing and able to deal with the intricacies of human cognition. The philosophy professors surveyed (and those I have known) rarely deal with cognitive psychology, and this is not their area of specialization. While educational psychologists may deal with the topic of cognition, only three of the respondents dealt with metacognitive processes. It seems that few education professors need to bother with topics related to cognition, so it seems unlikely that undergraduates can learn much about how we analyze, evaluate and justify our ideas (even if they are interested in doing so).

The same may be said (according to the data) for epistemology, which was not examined closely in any of the courses surveyed. It seems that, if students want to understand understanding, they may need to take some courses in their philosophy departments.

Affective dispositions did not seem to be a topic for much discussion in these courses, and there was a great deal of emphasis on the lack of students' interest in working on their own cognitive development. Students' lack of preparation for this work, their disinterest, the difficulty of the endeavour, and the constraints of classroom education, combined to form a powerful set of barriers between shallow and deep learning.

On the hopeful side, it is clear that the utility of teaching about cognitive skills was appreciated by half of the participants. This area of cognitive psychology has been developing for about 50 years, and it is possible that more and more educators will be studying this topic in future decades. Similarly, several of the respondents were clearly committed to the value of teaching for transformation; the phenomenon of self-transformation (including affordances such as psychotherapy and rehabilitation clinics) has been propagating itself throughout our society for some time, and some educators are beginning to appreciate that dynamic and emancipatory theories of learning call for learning by leaps and bounds, instead of incremental increases in knowledge.

It is also noted that several instructors remarked on the need to recognize, and to address, the individual needs of each student. This is important if students are to take responsibility for their learning, and if teachers are to be effective guides.

4. Study 2

Method

Participants

At the beginning of September 2007, I met with three instructors of education courses at a large (Eastern Canadian, English-speaking) university, to invite their participation in this project. Two of the instructors taught one-semester courses in philosophy of education (one course was held in the first term, and two in the second); the other taught a two-semester course in educational psychology. All three agreed to participate.

These instructors were selected because the subject matter of their courses contains complex and difficult material, and mastering the course content requires the coherent development of highly complex ideas. I requested, and was provided with, course syllabi and other course materials (including, in one case, reading guides for course content) that the instructors had prepared for their students.

Table 11 describes the designations and relationships of the four courses, three instructors, three teaching assistants and fourteen students.

Table 11. Courses, instructors, teaching assistants and students

Course designation	Semester(s)	Instructor	Teaching Assistant	Students
Course 1 (Phil of Ed)	Autumn 2007	I1	TA1	A, B, C, D
Course 2 (Phil of Ed)	Winter 2008	I1	TA1	E, F, M, N
Course 3 (Ed Psych)	2007/2008	I2	TA2	G, H, I, J
Course 4 (Phil of Ed)	Winter 2008	I3	TA3	K, L, M, N

I explained the research plan to the instructors. I planned to interview each of them at the beginning of the course (in the first two weeks of the term), and after the course was completed; I would observe several classes in each course (in a nonparticipatory fashion), and I would invite several students from each course (and also the teaching assistants) to be interviewed at the conclusion of the term.

During the course of the year, after observing some classes in each course, I invited some students from each course to talk with me at the end of the semester. Fourteen agreed to do so, four from each of the courses, including two students who completed both Course 2 and Course 4. These included nine females and five males, and including some of the more outspoken, and some of the more quiet, members of each class. Each of the students, on request, provided some samples of the work products that they had submitted for grading.

The three teaching assistants also agreed to participate in interviews at the end of the semester. All participants signed consent forms, to indicate that they freely volunteered to participate, and all were informed that they could withdraw at any time without any consequences to them.

Interviews

Twenty-two of the 23 semistructured interviews occurred face-to-face in private rooms; one was held by telephone (since the participant was in another city at the time).

The initial interview protocols for the interviews are presented in Appendices B (instructors) and C (students); the post-term interviews (Appendix D) with instructors and teaching assistant followed similar lines of inquiry, and were informed by my field notes from classroom observations

All interviews were aurally recorded (with the permission of the participants) and were transcribed for later analysis. A summary of each interview was produced and sent back to the participants for member-checking; most approved the summaries, but one instructor, one teaching assistant, and one student added some minor changes or clarifications to their ideas.

After collecting this data, two follow-up procedures seemed to be warranted; both involved the student participants. One of the courses (educational psychology) used an online discussion forum as an instructional method; the four students in this class were asked a set of questions (Appendix E) by telephone, to explore their participation in this assignment. In addition, I wrote to all of the students by email to ask one more question, inquiring about any difficulties, barriers and challenges that they noticed with regard to learning to develop complex and coherent sets of ideas. Eight of the fourteen students responded to this follow-up question.

Interview Data Analysis

Two other doctoral candidates (experienced teachers who are well versed in pedagogical theories) worked with me to corroborate the qualitative analyses of the interview data. The method of constant comparison (Strauss & Corbin, 1998; Creswell, 2002) was used; open, axial and selective coding was employed to yield conclusions about what works, in the experience of the participants, with regard to supporting and facilitating higher-order cognitive development with students of education. Grounded theory analysis was applied to discover what the participants thought about this area of their work. With regard to topics of instruction, analytic induction (hypothesis confirmation/disconfirmation) was employed to see whether the interviewees addressed the topics that were specifically targeted for investigation.

HyperRESEARCH™ software was used to assign open codes to every phrase or passage that was of pedagogical interest (with careful attention to ensure that no relevant parts of the texts were ignored or overlooked); this was the second project we coded together, and the processes were familiar. I coded one or two interviews together with each assistant; we discussed all of those codes until we agreed on all of them. After that, each assistant observed me coding an interview, and all the codes were again discussed until agreement was reached on every one. The assistants coded three or four documents each, and I analyzed the rest; all of the results were discussed, and all the codes were verified by two of us.

I downloaded the open codes and source texts from HyperRESEARCH™, and I used Excel™ to label the codes according to common themes (categories). I listed all of the open codes interview by interview, and I sorted the codes for each interview into broad categories. One assistant confirmed these classifications, after we had discussed and reorganized them according to mutually agreeable terms.

I performed the final axial coding (identifying sub-categories) by re-examining all the open codes, verifying their contexts in each interview. I divided the categories into sub-categories (and further divided the sub-categories into more specific items). I presented the results of these tentative analyses to an assistant, who examined each sub-categorization. We discussed all discrepancies between our ideas on this process, and we finally agreed on categories, sub-categories, and finer distinctions that reflected each open code according to the contexts of those codes in their respective interviews.

Class Observations

At the outset of each course, the instructors introduced me to their classes, and allowed me to explain my purpose to the students. I told them that I was studying the teaching and learning of complex subjects, and that I hoped to enlist some of them to participate in interviews after the course was over.

I observed a total of fourteen class meetings. In the first term, I attended three meetings of Course 1 and two classes of Course 3; in the winter session, I was present at three classes in each of Courses 2, 3 and 4.

At each class that I attended I recorded in longhand as much as I could of what was said and done by everyone present. As soon afterward as I could, I transcribed these notes for later review; the observations provided information on what actually happened in the classroom, including topics of conversation, methods of instruction, and individual (outcome) events. The transcribed field notes were sent to the instructors for review; one instructor responded, clarifying some of the things that I had noted.

The field notes were used to verify implementation fidelity, that is, to see that the instructors were following through on their plans (as discussed in our initial interviews and published in the course syllabi); they were also used to inform the post-course interviews with all the participants.

Survey of Students

At the end of the second term, I distributed a survey (Appendix F) to three of the classes (Courses 2, 3 and 4) to see which of the six topics being analyzed (critical thinking, critical dispositions, metacognitive self-regulation, self-regulated learning, epistemology and dynamic/transformative learning) had been discussed in the course. A rating of 1 indicated that the topic received no attention, while a score of 5 indicated that the topic was an important part of the course. The survey also asked the students to describe thinking skills and attitudes that are important in education, what they had learned about higher-order thinking, and instructional methods suited to higher learning.

Each student created a seven-character code (the first three letters of the street where they live, their birth month and birth day) which they marked on the survey, and which allowed for them to withdraw their responses at any time; no student asked to be withdrawn from the study.

Course Evaluations

Instructors 2 and 3 provided for review the anonymous student evaluation reports that are compiled by the university for every course.

Results

Course 1 (Instructor 1)

The first-semester philosophy of education course examined social issues as they apply in schools, including feminism, racism, disabilities and socio-economic differences. It combined contemporary readings with classroom discussion; grades were determined by evaluations of weekly responses to a standard set of questions about the readings, and two research papers. Attendance and participation in classes was also assessed and factored into the final grade.

Three to six male students, along with twenty to twenty-five females, attended the classes that I observed.

I observed three classes (near the beginning, the middle and the end of the term). In September, the instructor notified the students that "you will have to do a lot of learning on your own," because nobody could tell them the best way to teach in their classrooms. The students' job in this class was to "challenge the authority of the texts" which have regulated not only what we learn, but also how we learn. This also included challenging the authority of the instructor. The physical environment (arrangement of chairs and desks) was modified to form a circle, so that students could face each other as well as the instructor; this defined "our space for learning, and our space for interaction." Reference was made to the need to "observe our fundamental sets of presumptions, which determine how we understand things," and to the necessity to have "a safe place to communicate in." The need to create a learning community through open communication (including the responsibility to avoid insulting or offending others) was described as an essential process for the class. Inquiring into educational approaches to schooling in multicultural societies, students were asked to contrast three philosophical models for dealing with diversity ("Which is the best way?"); they were also asked what major groups can learn from minorities, and to what extent minority group members should integrate themselves with their neighbours.

In October I observed a class on gender identity and gender politics. A film was shown, which pointed to an alarming incidence of sexual discrimination and harassment in high schools; the influences of mass media (which glorifies the degradation of females) was described as the surface of the problem, a reflection of societal norms. The students were asked to explore the issue of sex discrimination in schools, but they realized that the problems start at home, where children of both sexes learn (implicitly, by observing their parents) that women are inferior to men. A lively discussion followed; students shared their experiences of interacting with members of both sexes in various social situations. The instructor concluded that you can't solve a problem without understanding its sources. "Solutions depend upon your beliefs about what's going on … you must first decide what you believe [about the source of the problem]." Students were asked about their views on the extent of gender discrimination in schools, and how such problems should be addressed.

In late November, the class discussed multiculturalism (a "function of difference"), and the question of equal treatment for all students. The instructor asked, "Do your students trust each other enough to say what they want to say? … People avoid issues for fear of giving offence." Schools are a microcosm; these difficulties persist after we graduate. The last half of the class was spent on questions of self-discovery and self-knowledge; what do our identities and our cultures mean to us, how do they determine the biases in our thinking, and how are these beliefs reflected in out interactions with others? The instructor concluded, "There is tension between demands for critical thinking, critical pedagogy, and the demand to preserve heritage. We want our kids to question things, but not to question us! It's a messy business, and a painful process, and the more you know, the more painful it is." Questions to students included, "How should we envision a multicultural classroom," and, "How do we come to know what we know?"

Course 2 (Instructor 1)

This second-semester course in philosophy of education reviewed various historical theoretical approaches to philosophy; in the first class the instructor acknowledged that, "Philosophy is usually very boring," so one aim of the meetings was to have fun (while discussing the issues). The issue of authority was addressed, including the origins of knowledge, as the students were asked, "How do we know the things that we know?" If the teacher is the centre of attention, does that signify that he or she is the source of knowledge and truth? The class was focussed on the possibility of changing this assumption about the source of knowledge, of viewing the knowledge that each of us creates, and the philosophies that each of us holds, as authentic knowledge. Students were asked probing questions, the answers to which required careful justification, such as what is the use of studying historical philosophy, how do we rationalize what we think we know, and whether our experience is equal to (or lesser than) the knowledge that we get from books.

Later in January, I attended a class meeting where the discussion concentrated on the contrasts between the ways that idealists and pragmatists approach knowledge, truth and reality. The instructor asked a series of questions about the nature of ideas, the qualities of objects, and the values that we associate with each of these types of phenomena. The discussion then turned back to origins of knowledge, and how our ideas about this subject affect our teaching strategies. If knowledge is preformed, then it should be presented; if knowledge is constructed, then it should be discovered; "The traditional model of education is that knowledge is transferred in one direction; that's why the physical space is arranged … with everyone facing the front where the teacher is." The importance of creating one's own philosophy (in the form of a mission statement) was underlined, as "A philosophy helps put strategies in perspective," and, "Our philosophical statements declare what we want to do (to compare with what we are doing). This is needed. It connects us with what we are doing and why we are here." Students were asked to describe the value of discussion, to elucidate their philosophies of education, and to explain the purpose of their participation in education (and in the world).

I observed a third class in March, which explored the influences of feminism on educational philosophy, and awareness of gender differences in education. Students were asked whether there is a place in education for feminist philosophy; according to the instructor, educational research and administration are "predominantly male-centred," and there should be a place for feminist perspectives. "If experience is the source of knowledge, and women have different experiences than men, then they know things that men don't. The idea is that only those who experience repressive situations can know how it feels. My impression … is that education does not reflect knowledge that comes from women's ways of knowing."

The grading criteria for this course were similar to those for Course 1: weekly reports on the readings, two research papers and a participation grade. The number of students (about thirty per class) was also similar to Course one, as were the proportions of males and females.

Course 3 (Instructor 2)

The two-semester course in educational psychology contained forty students at the first session I attended (the second class meeting); twenty-one were present at the fifth and last observation session in April (forty-two were registered at the end of the year). Four male students were in the classes that I observed.

Course materials included a textbook, with topics ranging through cognitive and moral development, disabilities, behaviourism, cognitivism, constructivism, motivation, and learning environments. Metacognition was covered in four paragraphs, as was reasoning. Critical thinking ("objective," as opposed to subjective, ways of knowing) also received about four paragraphs worth of attention; self-regulation (defined as goal-setting, strategy use, self-monitoring and self-correction) occupied seven pages of the text.

Assessment criteria were based on attendance, three exams, and a research project (a research paper or a student teaching project). Classes included a mixture of videos, slide presentations, discussions, and other activities (such as small group projects and educational games).

Class session two inquired into the relationships between brain functions, learning and cognitive development. A video was presented, which showed an entertainer performing a startling illusion (an apparent decapitation), and a lively discussion ensued about the reactions that small children might have to such an exhibition. ("Can you imagine what happens when a five-year-old, who is unfamiliar with illusions, sees this? It's horrifying!") The Piagetian theory of cognitive equilibrium (learning through conflict, which produces *disequilibrium,* followed by *assimilation* and *accommodation*), was discussed. Other video clips were presented, on different ways of teaching young children ideas related to mathematics and physics. Students were assigned homework; they were asked to create their own ideas for teaching strategies according to different teaching styles, and were asked to post their results in the online class discussion forum.

The second class I attended (in October) began with a ninety-minute slide presentation and class discussion on education in multicultural societies. The idea of ethnocentrism was explored, during which one student (Student I) asked, "Isn't everybody ethnocentric?" The instructor asked, "Is there a Canadian culture?" and the discussion focussed on applications of cultural values to educational processes; a wide range of opinions was expressed. The instructor also asked, "Do you think immersion is more or less beneficial for achievement?" The last part of the class was spent in a small-group exercise, planning a multiculturalism exhibition at a public school.

I visited two classes in January; one on complex cognition, and the other about motivation and related constructs (including self-efficacy and self-regulation). In the first session, the instructor presented ideas about types of knowledge, and structures of meaning, and informed the students of the importance of organizing our ideas (including the practice of concept mapping, which was the focus of a group exercise on mapping the constructivist perspective). Students were asked, "What [cognitive] processes did you use to solve this problem?" What social negations did you go through?" In the class on motivation, a long presentation and discussion explored self-efficacy, goal setting, self-esteem, attribution theory, empowerment, and mastery beliefs. Students also played a game, where they set the difficulty of their task (throwing a ball into a basket) by deciding how close to stand to the target (a demonstration of self-efficacy beliefs, and of the need to set tasks that are neither too easy nor too difficult).

The fifth class that I attended examined processes associated with educational assessment; the instructor asked the students about their concerns and preferences for how their learning is evaluated. The slide presentation focussed on forms of measurement, and combining different forms, with an eye to fairness, validity and reliability; the instructor emphasized the need for scoring rubrics. The instructor shared, "I like essays; it gives students a chance to show what they've got." The class ended with a presentation on statistical concepts for the analysis of quantitative data.

Course 4 (Instructor 3)

This course in philosophy of education combined readings from ancient philosophy with others from the Enlightenment era, as well as material from the nineteenth and twentieth centuries. Thirty-four to thirty-eight students attended the three sessions I observed (forty-four were registered at term's end); eight were male.

In mid-January, the class discussed social life in ancient Athens, along with Plato's views on human thought and human education (including the depths of the metaphorical cave in which humans beings have been shielded from the brilliance of ideas, and the constitutional qualities that distinguish people of various abilities). The subject was presented with slides illustrating the content, and the instructor prompted the class to supply the main ideas from the readings. A group exercise allowed the students to design curricula around Plato's ideas of what children should (and should not) learn. The instructor asked whether our societal system could be compared with Plato's notion of *meritocracy*, and the relevance of lying to the citizens (or to our children) was explored. (In the process the instructor reminded the class that Santa Claus *does* exist – as a "cultural construct.") The instructor compared the allegory of The Cave to the movie The Matrix, and asked the class, "What does Plato mean by, 'People are possessed by shadows'?"

In March the class viewed a movie on indoctrination into Christian culture, which illustrates how children learn to become "seized by the Holy Spirit" and are inspired to follow the principles of their religious leaders. ("The Devil uses tactics to destroy our lives. He tempts you with Sin – Sin will grow in your life until it controls your life.") The instructor asked the class if the leading character in the documentary (a protestant pastor) was sincere, inquiring, "Does believing that you're doing the right thing let you off the hook? Is it still wrong?" This was followed by a discussion of theories of indoctrination, during which a student (Student M) criticized the character in the film, saying, "[The pastor] doesn't teach critical thinking at all. Any teacher should make an attempt to teach critical thinking." The instructor agreed, adding "There's no opportunity for people to make a thoughtful and rational choice. We have to leave space for views to be criticized." A debate (for which students had prepared their roles) followed, regarding the issue of parental rights with regard to school activities and home schooling. In the ensuing discussion, the instructor noted, "We all have trouble being neutral because of our biases."

In April the class discussed multiculturalism in education (a common thread in three of the four courses that I observed). The instructor also provided three "killer characteristics of bad papers" (no coherent story, runs out of gas, and no new analysis); and listed several other problems for writers (including lack of a clear thesis statement, and an inadequate introduction). There was a class debate about immersion in parochial education; the instructor asked the class whether a common culture is necessary, whether "violent splintering" is inevitable without adequate common ground. ("Is this just fear mongering, or is there a basis in fact?") In response to the idea (proffered by Student K) that "Race is a myth; it's an artificial distinction," the instructor replied, "'Artificial' distinctions are operative in our ideas and actions; just because they're arbitrary doesn't mean that they don't cause real problems. So we can't ignore the issue, or claim that it has no interest … to us. Asking, "Are we all always-already biased in our views," the instructor confirmed that such is the cases, indicating, "So being aware of your bias is key."

Assessment in Course 4 was based on four short essays, two exams, and a research paper.

Interviews

The summaries of each of the twenty-three interviews are presented in Appendix G.

Ultimately, eight hundred fifty three elements were coded from twenty-three interviews (fourteen with students, and nine with instructors and teaching assistants). Nine broad categories (themes) of interest were identified. Topics of instruction were specifically targeted for investigation; aside from this category, eight other pedagogical themes emerged from the analysis. Table 12 provides definitions for these categories, as they were ultimately applied in this process of classification.

Table 12. Categories of open codes with their descriptions, and the total number of codes assigned in each category

Categories	Category Description	Frequency (Instructors)	Frequency (Students)
Topics	Course content on higher order thinking; subject matter specifically discussed by the instructor	35	41
Objectives	Learning objectives with regard to cognitive performance	94	128
Methods	Instructional methods used in the courses under consideration and described during the interviews	84	57

Challenges	Problems, obstacles or difficulties that present barriers to teaching and learning with regard to higher order thinking	40	38
Outcomes	Specific results (achievement or satisfaction)	49	19
Perspectives	Ideas, beliefs or opinions about the processes of teaching and learning with regard to higher order thinking	63	78
Dispositions	Dispositions related to teaching and learning cognitive skills	19	55
Assessments	Pedagogical value judgements with regard to events, conditions or situations	18	14
Learning Strategies	Actions that support the learning of cognitive skills and complex materials	7	14

Appendix H contains all of the open codes, along with their minor sub-categories, course by course, separated according to the results from teachers and from students. These results convey details of the conversations, which are lost when the abstract categories and sub-categories are presented in their absence.

Some of the categories (objectives, methods, outcomes, and perspectives) seemed more complex than the others when it came to the process of sub-categorization. For the sake of clarity, some of these classifications were therefore organized into major and minor sub-categories; the latter concepts refer to more particular types of objective, method, outcome, or perspective than are conveyed by the major sub-categories.

Topics

The various topics that were named in the interviews are presented in Tables 13 and 14. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each sub-category.

Sixty-seven students from three classes provided responses to the in-class survey (Appendix F) that was administered in the last two weeks of the term. Tables 15, 16 and 17 present the results of the survey questions on the topics discussed in class. Average scores for the inclusion of topics, and for time spent learning each topic, were calculated out of a maximum of 5.

The second part of the survey asked students to express briefly their pedagogical views on higher-order thinking; the answers to these questions (offered by students who were not interviewed for this study) are presented in Appendix I.

Table 13. Topics of instruction reported by six instructors and teaching assistants

Topics **Sub-categories** **Instructors and Assistants**	**Frequency**
epistemology	4
self-regulated learning	4
critical thinking	3
metacognition	3
critical dispositions	3
transformative learning	3
learning strategies	2
alienation	1
ancient philosophy	1
bias and neutrality	1
controversies in education	1
emancipative learning	1
history of education	1
indoctrination	1
learning theories	1
multiculturalism	1
Plato's Ideals	1
preparing for tests	1
religion	1

Topics Sub-categories Instructors and Assistants	Frequency
epistemology	4
setting goals	1
social constructivism	1
teacher neutrality	1

Table 14. Topics of instruction reported by fourteen students.

Topics Sub-Categories Students	Frequency
critical thinking	12
critical dispositions	8
self-regulated learning	7
epistemology	6
metacognition	5
transformative learning	3

Table 15. Topics rated by twenty students in Course 2

Topic	Importance in Course	Time Spent Learning
critical thinking	4.1	3.25
critical spirit	3.63	3.20
metacognitive self-regulation	3.25	3.10
self-regulated learning	3.50	3.40
epistemology	3.80	3.40
transformative/dynamic learning	3.05	3.10

Table 16. Topics rated by twenty-one students in Course 3

Topic	Importance in Course	Time Spent Learning
critical thinking	3.90	3.29
critical spirit	3.19	2.95
metacognitive self-regulation	3.76	3.38
self-regulated learning	3.86	3.62
epistemology	3.32	2.89
transformative/dynamic learning	2.75	2.60

Table 17. Topics rated by twenty-eight students in Course 4

Topic	Importance in Course	Time Spent Learning
critical thinking	4.75	4.07
critical spirit	4.39	3.79
metacognitive self-regulation	3.39	3.14

Topic	Importance in Course	Time Spent Learning
self-regulated learning	3.81	3.56
epistemology	3.93	3.68
transformative/dynamic learning	3.56	3.32

Objectives

The instructional objectives that were described in the interviews are presented in Tables 18 and 19. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each major sub-category and to each particular item.

Table 18. Learning objectives reported by six instructors and teaching assistants

Objectives Sub-Categories Instructors and Assistants	Frequency	Objectives (Frequency)
metacognition	6	reflective thinking (4)
		self-evaluation (2)
		self-monitoring (2)
		metacognition (1)
cognitive skills	6	examine alternative perspectives (5)
		comprehension (4)
		critical thinking (4)
		argumentation skills (3)
		create meaning (3)
		evaluation skills (3)
		analysis skills (2)
		careful thinking (2)
		synthesis skills (2)
		analyze controversial issues (1)
		avoid prejudgement (1)
		awareness of biases (1)
		change thinking (1)
		consider contradictions (1)
		consider implications (1)
		consider learners' perspectives (1)
		distinguish facts from ideas (1)
		draw rational conclusions (1)
		examine identities (1)
		get a feeling for the material (1)
		identify central issues (1)
		interdisciplinary thinking (1)
		internalize theories (1)
		justify conclusions (1)

Objectives Sub-Categories Instructors and Assistants	Frequency	Objectives (Frequency)
		think for change (1) think new ideas (1) think outside the box (1) understand relevance of subjectivity (1)
inquiry skills	6	inquiry skills (4) question assumptions (3) clear questions (1) find facts (1) question beliefs (1) question what you're told (1) seek out differing perspectives (1)
practical skills	5	apply the material (4) create and test hypotheses (1) create change (1) help others (1) improve teaching practices (1) observe accurately (1) respond appropriately in context (1)
communication skills	4	communication skills (2) explanatory skills (2) writing skills (2) reading skills (1) responsible self-expression (1) social awareness (1)
dispositions	2	open-mindedness (1) scepticism (1)
student engagement	2	
challenge authority	1	
empowerment	1	
self-regulated learning	1	

Table 19. Learning objectives reported by fourteen students

Objectives Sub-Categories Students	Frequency	Objectives (Frequency)
cognitive skills	14	analytical thinking (8) independent thinking (8) critical thinking (7) evaluation skills (7) consider alternatives (6) connecting ideas (5) creative thinking (4)

Objectives Sub-Categories Students	**Frequency**	**Objectives (Frequency)**
		deeper thinking (4) memorizing (3) argumentation skills (2) broad thinking (2) synthesis (2) abstract thinking (1) consider hypothetical situations (1) distinguish relevant information (1) form coherent conclusions (1) justification (1) objectivity (1) problem solving skills (1) rational thinking (1) structured thinking (1) unbiased thinking (1)
metacognition	11	reflective thinking (5) metacognition (4) self-monitoring (3) self-reflection (3) self-awareness (2) self-discipline (1) self-evaluation (1) self-expression (1) self-organization (1)
comprehension	9	comprehension (9)
apply the material	6	apply the material (6)
self-regulated learning	5	self-regulated learning (3) set goals (1) set learning priorities (1) use self-regulation strategies (1)
changing perspectives	4	changing perspectives (2) new ideas (2)
self-development	2	self-development (2)
argumentation skills	2	
challenge authority	1	
consider fairness and justice	1	
communication skills	1	self-expression
develop moral character	1	
find proof	1	

Objectives Sub-Categories Students	Frequency	Objectives (Frequency)
finding answers	1	
inquiry skills	1	
inspire motivation	1	
no bluffing	1	
peace and love	1	
sensing	1	
transform society	1	

Methods

The instructional methods that were described in the interviews are presented in Tables 20 and 21. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each major sub-category and to each particular item.

Table 20. Instructional methods reported by six instructors and teaching assistants

Methods Sub-Categories Instructors and Assistants	Frequency	Methods (Frequency)
dialogue	6	discussion (4)
		demand justifications (2)
		avoid lecturing (1)
		be available (1)
		be responsive (1)
		confirm comprehension of main ideas (1)
		demand explanations (1)
		describe cognitive skills (1)
		empathic listening (1)
		encourage communication (1)
		moderate the discussions (1)
		online discussion forum (1)
		present controversial ideas (1)
		present false information (1)
		present information (1)
broad analysis	5	examine alternative perspectives (5)
		multi-disciplinary approach (1)
inquiry	4	ask questions (4)
		ask for definitions (1)
provide guidance	4	provide guidance (3)

Methods Sub-Categories Instructors and Assistants	Frequency	Methods (Frequency)
		provide reading guides (2)
		provide structure (1)
activities	3	discuss metaphysics (1)
		do experiments (1)
		evaluate newspaper articles (1)
		examine conflicting data (1)
		experimental research project (1)
		explain consequences of plagiarism (1)
		games (1)
		quizzes (1)
		search online during class (1)
		self-analysis questionnaire (1)
		self-evaluation questionnaire (1)
		small group work (1)
		students brought materials (1)
		use examples (1)
		vote on ideas (1)
		warn students of difficulties (1)
		discuss metaphysics (1)
foster critical faculties	3	
link material to personal experience	3	
modelling cognitive skills	3	
provide meaningful contexts	3	
use broad approach	2	provide access to variety of materials (1)
		provide variety of activities (1)
competitions	1	
de-emphasize outcomes	1	
deep analysis	1	
demonstrations	1	
discount idea of 'truth'	1	
pose problems	1	
provide multiple ways to learn	1	
provide opportunities for unpredictable outcomes	1	
provide practice questions	1	
reflection	1	
remind students to think critically	1	
safe space	1	
stem the panic	1	
systematic approach	1	
teach critical thinking implicitly	1	
teach learning strategies	1	
writing assignments	1	

Table 21. Instructional methods reported by fourteen students

Methods Sub-Categories Students	Frequency	Methods (Frequency)
dialogue	10	discussion (8)
		present basic information (1)
		present controversial ideas (1)
		present false information (1)
		present justifications (1)
		provide feedback (1)
		student presentations (1)
provide guidance	7	provide guidance (2)
		provide good readings (1)
		provide opportunities for higher order thinking (1)
		provide options (1)
		reinforce students' self-regulative work (1)
		step-by-step teaching (1)
analysis	5	clarify distinctions and relationships (2)
		critical analysis (2)
		contrast viewpoints (1)
broad approach	3	offer alternative perspectives (3)
deep approach	3	evaluate students' cognitive processes (1)
		examine arguments (1)
		point out exceptions to rules (1)
inquiry	3	ask questions (2)
		avoid asking too difficult questions (1)
modelling	2	
use relevant materials	2	
writing assignments	2	
collaborating	1	
consider students' personalities	1	
deep analysis	1	
foster critical faculties	1	
inquiry	1	
make it fun	1	
use broad approach	2	
provide a safe space	1	
provide freedom to think	1	
stimulate curiosity	1	
teach learning strategies	1	
use a variety of methods	1	
use conflict	1	
use holistic approach	1	

Challenges

The challenges to teaching and learning higher-order thinking, as described by the respondents, are shown in Tables 22 and 23. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each sub-category.

Table 22. Challenges reported by six instructors and teaching assistants

Challenges Sub-Categories Instructors and Assistants	Frequency
some students did not engage	5
lacking preparation for CT	4
discomfort	3
failure to comprehend	3
student resistance	3
difficult material	2
wanting the right answer	2
can't measure thinking	1
confusion	1
difficult assignment	1
difficult to learn to think critically	1
difficult to maintain appropriate scepticism	1
difficult to manage participation	1
hard to assess engagement level	1
large class	1
materials are biased	1
not enough time for deep analysis	1
over-participation	1
poor physical layout	1
some students lacking basic skills	1
students focus on grades	1

Table 23. Challenges reported by fourteen students

Challenges Sub-Categories Students	Frequency
overcome biased thinking	4
some people accept ideas too easily	3
applying the material in practice	2
difficult material	2
difficult to teach thinking skills	2
remembering things	2
some people are closed-minded	2
assignments were too open-ended	1

Challenges Sub-Categories Students	Frequency
comprehension	1
difficult to think independently in an academic context	1
don't know what higher order thinking is	1
gain students' confidence	1
never learned about higher order thinking	1
not enough time	1
professors assume too much	1
truth is a confusing subject	1

Outcomes

The educational outcomes described in the interviews are shown in Tables 24 and 25. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each sub-category.

Table 24. Outcomes reported by six instructors and teaching assistants

Outcomes Sub-Categories Instructors and Assistants	Frequency	Outcomes (Frequency)
good performance	6	good student performance (4) critical analysis (3) challenged authority (1) enrolled in following course (1) exceeded expectations (1) good communication (1) independent thinking (1) self-regulated learning (1) student brought material to class (1) student did extra work (1) student inspired others (1) students learned to cite evidence (1) student worked hard (1)
student satisfaction	6	students happy/satisfied (6) good lectures (1) student became interested in graduate school (1)
improved thinking	5	
new comprehension	5	awareness of new possibilities (3)

Outcomes Sub-Categories Instructors and Assistants	**Frequency**	**Outcomes (Frequency)**
		changed perspectives (1) learned to moderate discussions (1)
students were motivated	3	motivated beyond getting grades (1) student enthusiasm (1) students encouraged by safe space (1) students kept in touch (1)
poor performance	2	poor student performance (2) poor writing (1)
student dissatisfaction	1	
open-mindedness	1	
safe space	1	
some lessons failed	1	
students wanted more testing	1	
transformed perspectives	1	

Table 25. Outcomes reported by fourteen students

Outcomes Sub-Categories Students	**Frequency**	**Outcomes (Frequency)**
changed perspectives	4	changed perspectives (4)
increased metacognition	4	increased self-reflection (3) learning to self-regulate (1) self-discovery (1)
improved thinking	3	increased comprehension (2) better thinking (1)
good performance	2	being more versatile (1) better planning (1)
self-regulated learning	2	setting goals (2)
considering other perspectives	1	considering other perspectives
motivated to continue studies	1	intend to study more psychology
poor performance	1	superficial work on journal assignments

Perspectives

The pedagogical perspectives gleaned from the interviews are shown in Tables 26 and 27. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each sub-category.

Table 26. Perspectives reported by six instructors and teaching assistants

Perspectives Sub-Categories Instructors and Assistants	Frequency	Perspective (Frequency)
pedagogical approach	6	everyone can contribute (2)
		important to challenge the students (2)
		need to consider learners' perspectives (2)
		good visual images very important (1)
		important to clarify questions (1)
		important to cultivate critical dispositions (1)
		important to teach and learn higher order thinking (1)
		need more depth (1)
		need more quizzes (1)
		need to apply the material (1)
		need to be discomfited (1)
		need to inject new content (1)
		need to model cognitive skills (1)
		need to read a lot (1)
		need to read carefully (1)
		need to use a systematic approach (1)
		need weekly online discussions (1)
		shouldn't assume students' preparation or interest (1)
		some students want structure (1)
		students expect direct approach (1)
		students like lectures, multiple choice (1)
		students need guidance (1)
thinking and knowing	6	critical thinking not a single skill (2)
		everybody is always biased (2)
		memorizing not enough (2)
		better to see knowledge as infinite (1)
		can't measure thinking (1)
		colonialism undermined cultural perspectives (1)
		critical thinking is systematic organizing of ideas and strategies (1)
		critical thinking needs context (1)
		critical thinking requires background knowledge (1)
		declarative ideas are closed-ended (1)

Perspectives Sub-Categories Instructors and Assistants	Frequency	Perspective (Frequency)
		difficult to assess transformative learning (1) easier to learn declarative knowledge (1) epistemology not a priority (1) higher order thinking is exploratory (1) knowledge is not about truth (1) need to understand knowledge (1) no one right answer (1) philosophy requires unique approach (1) takes a long time to learn (1) there are multiple truths (1) transformative thinking related to critical thinking (1) truth is consensual (1) we can develop intellectual skills (1)
need to select good materials	3	
need to plan carefully	2	
teach thinking explicitly	2	
teach thinking implicitly	2	
value creativity	2	
low expectations	1	
materials are biased	1	
need to communicate	1	
need to rethink syllabus	1	
need to write well	1	
teacher-student collaboration necessary	1	

Table 27. Perspectives reported by fourteen students

Perspectives Sub-Categories Students	Frequency	Perspective (Frequency)
thinking and knowing	12	important to think critically (4) need to teach and learn thinking skills (3) truth is relative (3) can't force higher-order thinking (2) complex thinking comes with age (2) higher order thinking takes practice (2) knowledge is knowing the truth (2) knowledge is subjective (2) need background knowledge (2) better knowledge is more philosophical (1) can't force transformation (1) classroom not best place to learn higher order thinking (1) cognition is related to emotion (1)

Perspectives Sub-Categories Students	Frequency	Perspective (Frequency)
		critical thinking not about truth (1) don't need to be evaluative (1) empathy applies for thinking (1) everybody is always biased (1) knowing involves light (1) knowing involves truth (1) knowing not just about truth (1) knowledge changes with time (1) knowledge comes from experience (1) knowledge is "academic" (1) knowledge is a passing state (1) knowledge is conditional (1) knowledge is relative (1) language can't completely describe knowledge (1) metacognition is not a constant process (1) more than one right answer (1) need evaluation skills (1) need social perspective on knowledge (1) need time to absorb material (1) need to base knowledge on experience (1) need to realize that things are not as they appear (1) need to understand knowing (1) need to use intuition (1) no fixed rules for higher order thinking (1) peer group influences learning (1) people want truth (1) reward system determines learning (1) self regulation depends on context (1) teachers don't encourage higher-order thinking (1) thinking is a social phenomenon (1) thinking is not a passive process (1) true knowledge is proven (1) truth is a confusing subject (1) truth is incremental (1) understanding is contextual (1) understanding takes a long time (1) we create knowledge (1)
pedagogical approaches	10	need to consider alternative perspectives (4) importance of self-regulated learning (2) need to work with others (2) learning is lifelong (1) need appropriate methodologies (1) need conducive physical space (1) need conducive social space (1)

Perspectives Sub-Categories Students	Frequency	Perspective (Frequency)
		need high expectations (1) need learning strategies (1) need peace education (1) need some conflict (1) need to focus on moral character (1) need to learn step by step (1) need to make learning interesting (1) need to question everything (1) need to tailor the learning environment (1) need to teach learning strategies (1) subject matter should be interesting (1) teachers should be guides (1) there's injustice in everything (1)
important to behave morally	1	
learning is an activity, not a goal	1	

Dispositions

The dispositions that support higher-order cognitive development, as described by the participants, are shown in Tables 28 and 29. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each sub-category.

Table 28. Dispositions reported by six instructors and teaching assistants

Dispositions Sub-Categories Instructors and Assistants	Frequency
open-mindedness	4
scepticism	2
acknowledge one's fallibility	1
critical dispositions	1
curiosity	1
enthusiasm	1
go past discomfort	1
importance of a positive attitude	1
inquiring disposition	1
intend to learn from mistakes	1
need to care about topic	1
need to continually inquire	1
need willingness	1
positive attitude	1
questioning	1

Table 29. Dispositions reported by fourteen students

Dispositions Sub-Categories Students	Frequency
motivation	7
open-mindedness	7
curiosity	6
perseverance	5
flexibility	4
positive attitude	3
questioning what you're told	3
empathy	2
purposefulness	2
question one's own ideas	2
adaptability	1
attention span	1
being organized	1
concentration	1
critically disposed	1
humility	1
patience	1
poise	1
relatedness	1
resilience	1
respect	1
self-confidence	1
self-control	1
tolerance	1

Assessments

The participants' assessments of their pedagogical situations are reported in Tables 30 and 31. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each sub-category.

Table 30. Assessments given by six instructors and teaching assistants

Assessments Sub-Categories Instructors and Assistants	Frequency
some students did not engage	5
need to improve methods	3
students were interested in critical thinking	2
students were engaged	4

Assessments Sub-Categories Instructors and Assistants	Frequency
wide variety of outcomes	2

Table 31. Assessments shared by fourteen students

Assessments Sub-Categories Students	Frequency
class discussions not helpful	2
class discussions very helpful	2
no thinking instruction in schools	2
the course wasn't about thinking	2
assignments were too open-ended	1
poor education system	1
safe environment to participate	1
schools dehumanizing	1
too teacher-centred	1
well-moderated discussions	1

Learning Strategies

The participants' assessments of their pedagogical situations are reported in Tables 32 and 33. Frequencies refer to the number of participants (out of six teachers and fourteen students) who referred to each sub-category.

Table 32. Learning strategies recommended by six instructors and teaching assistants

Strategies Sub-Categories Instructors and Assistants	Frequency
identify important ideas	1
evaluate and modify ineffective learning strategies	1
concept mapping	1
keep a learning journal	1
read carefully	1
restate important ideas	1

Table 33. Learning strategies mentioned by fourteen students

Strategies Sub-Categories Students	Frequency
re-reading the material	3
affective self-regulation	1
consult others	1
create an action plan	1
evaluate usefulness of material	1
examine changes in perspective	1
generate motivation	1
get help	1
highlight relevant parts of texts	1
keep notes, records	1
self-talk	1
take breaks from difficult study	1
take your time	1

Findings

The three instructors' enacted varying styles of building classroom learning communities. Instructor 1, a philosopher with nearly two decades of teaching experience, spent the class time weaving a continuous discursive thread around the class topics, inviting the students to join the conversation; there was relatively little variety in the methods used in Courses 1 and 2 (although I did see one video presentation in the first term). The other two instructors used slide presentations accompanied by instructor discourses and class discussions. Instructor 2 (a psychologist who also has nearly twenty years of experience) used videos, games, group projects and competitions during class time, while Instructor 3 (teaching for the second year) used in-class student debates to vary the mix of activities. Course 3 also used an online discussion forum; however, according to the interviews, this tool was not employed to its greatest advantage. Courses 3 and 4 maintained course websites where the instructors posted supplementary materials.

All the teachers expressed their commitments to their students' cognitive development. They all wanted their students to go beyond understanding the material that they gleaned from the curricula; in addition to changing *what* they think, these instructors want their students to change *how* they think. Instructor 1 emphasized figuring out new ways to put things together (thinking outside of the box, thinking for change); Instructor 2 stressed the need for increased reflection and deep understanding, while Instructor 3 shared Instructor 2's aims, and also underlined the need for "deliberate and systematic" efforts at dealing with complex ideas. All of the instructors reported a wide disparity in their students' preparedness to engage with complex subject matter, and the course outcomes reflected this variability.

The following sections will explore the results of the interview data, concentrating on the main themes that emerged from my discussions with instructors and students.

Topics

In addition to the topic areas under investigation, several other subjects of instruction were mentioned in the interviews. These included multiculturalism (three courses), learning theories (Course 2), and (from Course 3) the subjects of indoctrination, alienation, bias and neutrality, religion, ancient philosophy, and social constructivism. Each of these subjects can serve as excellent material for the construction of complex networks of concepts, in consideration of the complex interactions of epistemological (justificatory) and psychological (cognitive and behavioural) processes.

It is interesting to note that the student survey data (average ratings of the topics covered, Tables 21 to 23) indicated that the students generally agreed that all of the topics that I asked about were covered in each of the three courses surveyed (with a single exception). Average ratings greater than 3.0 suggest that (except for transformative learning in Course 2) the students recalled some course content that was associated with every topic surveyed. This might be the result of the Hawthorne Effect; it is possible that the students were disposed to produce positive ratings on these questions in order to fulfill their ideas about my purpose for the survey. However, the highest ratings generally reflect the instructors' ideas about what was discussed in each course (critical thinking, epistemology and critical spirit in Course 2, self-regulation and metacognition, in Course 3, and critical thinking and critical spirit in Course 4); thus the students were apparently attuned to the instructors' beliefs that these topics were covered in the classes. It is also possible that many of the students maintain an active interest in all of the topics surveyed, and that their ratings reflect this interest. The students may have read into the materials some relevance to concerns for epistemological clarity, self-regulation and transformational learning, even though the instructors did not specifically cover these topics.

Critical thinking apparently received more class time than Instructor 3 had anticipated. Although not originally tending to treat the subject, this teacher found that it was necessary to do so. ("I had to talk about that in a much more deliberate and specific way than I ever had to do before …There were some students who were far less prepared than I anticipated they would be … which is a significant problem."). Instructor 2 also claimed to have taught about critical thinking skills in the educational psychology course. Twelve of fourteen students interviewed said that critical thinking had been a topic of instruction in their courses.

Critical dispositions were emphasized in Course 4, as reported by the Instructor and the TA; Student L agreed that the topic had been discussed in that class. Teaching assistant 1 mentioned that some attention was paid to affective factors in Courses 1 and 2, and six students agreed that this was the case. In Course 3, only one student, and neither teacher, claimed that critical dispositions were mentioned. It's interesting that, while motivation is an important subject in educational psychology, this class did not deal with the affective aspects of critical thinking.

Epistemology was discussed (to some extent) in all of the courses, according to Instructors 1 and 2, and TAs 1 and 3; two students from each of these courses agreed that this was the case. However, nobody claimed that this area was a topic of much discussion (presumably because it is a difficult subject, and one that is hardly relevant to the curricular goals of these courses). I observed Professor 1, on four occasions, asking the assembled class the question, "How do we know what we know"; no student ever responded to this query, and the subject was not pursued on these occasions.

It seems that the three instructors, who all demonstrated high degrees of epistemological sophistication in their own discourses, might have underlined to the students a few of the important things that educators have learned from two and half millennia of philosophical research into understanding knowledge and knowing. For example., it might be useful for learners to understand that no theory of knowledge has been reliably demonstrated to be the single true or right way to distinguish better and worse knowing (or true and false knowledge). It might support many people's cognitive advancement if everybody understood that the correspondence theory of truth (the idea that a true belief is one that accurately corresponds to a reality that cannot be directly perceived) is unverifiable and unfalsifiable (that is, incoherent), because we can never manage to compare our models to that which is imperceptible. Similarly, pedagogical conditions may be improved if everyone understood the limits of such ideas as materialist monism, the metaphysical stance which eschews the reality of immaterial objects (such as human ideas and other experiential things) – we can't explain away our experiences by claiming that they're not real. Other philosophical positions, which people have adopted through hearsay evidence, may also be eschewed (recontextualized as unjustifiable) if people confront them directly through educational interventions; for example, the epistemological theory of positivism claims that the only valid knowledge is that which can be directly verified through measurements, but (unfortunately for adherents) this foundational principle is invalid according to its own specification. Many individuals have found new openings for breakthroughs in cognitive development by invalidating the assumptions that justified their networks of beliefs; unlearning is an important process in managing to widen our coherent frames of conception.

The importance of epistemological sophistication has been underlined by philosophers of education and by educational researchers alike; it seems that more effort could be made to increase students' awareness of the relevance of this topic to higher cognitive development. At the very least, they can learn to be leery of dogmatic insistence on the validity, or the value, of any particular approach to knowing and understanding. This may be accomplished, in the best contemporary traditions developed over the last century, by informing them of the work of some of the brilliant philosophers (from Nietszche to Foucault, Habermas and Derrida; from William James to Donald Davidson and Richard Rorty) who have elucidated the practical limits of epistemic certainty, and who have recommended the (pragmatic, post-structural) approach of bracketing the discourses which articulate the justifications for our (always-contingent) intellectual assessments.

Objectives

The participants named a variety of cognitive skills as learning objectives, most of which seem to be relevant to the (critical, analytical, inferential, evaluative, creative, and affective) processes which contribute to the construction of complex and coherent networks of ideas. The instructors emphasized the consideration of alternative approaches to a subject; critical thinking and comprehension were also important objectives for this group, as were argumentation and meaning-making. A host of related sub-skills were also named, some of which relate to dispositions (becoming more sceptical and more open-minded), to social awareness and social skills, and to creating change.

The students also proffered a variety of competencies as cognitive objectives. Analytical thinking headed the list, as did independent thinking (the latter of which was not, it seems, highly valued by their instructors). Three students considered memorizing an important skill; none of the instructors thought that this process is related to higher-order cognition; on the other hand, Instructors 2 and 3, and Teaching Assistant 3, prized argumentation skills, while only Students E and K mentioned the importance of articulating our justifications.

Eleven students and four teachers agreed on the relevance of metacognition. Two teachers and one student named self-evaluation as an objective, self-correction was never mentioned (although "thinking for change" might be seen as learning to change oneself for the better). It is possible that the teachers and students who mentioned reflection already assumed that the purpose of reflection is self-evaluation and self-correction; they may have understood this, and felt no need to mention these goals as well.

Only Student I named inquiry skills as a learning objective; this datum may indicate a failure of emphasis on this objective by the instructors, all of whom agreed on its importance.

Five teachers and six students named practical skills (applying the subject material in practice) as important goals. These objectives seem to be important in any professional program; it is possible that all of the participants are concerned about such goals, and that this was not evidenced by more of them because the focus of the interviews was cognitive development (rather than other, more immediately practical, concerns).

An interesting note is that, out of all twenty participants, only one (Student E), evinced a concern for ethics (including social justice, peace education, and moral character development) in higher cognitive development. The fact that none of the other nineteen participants referred to ethics or morality suggests that the topic is not closely associated, in their communities, with the pedagogy of higher-order thinking; only Course 2 included any material on this subject. While all of the respondents might have considered ethics relevant (had I asked them to share their considerations about this), it is also possible that ethics and morality have not been established as important concerns in the education of these students. If that is the case, it may be interpreted as a reflection of an indifference to ethical self-regulation, and as an indication of a failure to attend to the development of our citizens' moral judgments.

Student H recommended that instructors manage to "generate motivation" in their students; this is consistent with the objective of "student engagement" that was stated by Instructors 2 and 3. This objective (which does not refer to educational outcomes, but to the processes involved in learning), should be of especial interest to educators, since students' willingness to participate in their own educations seems to be related to learning outcomes.

Some of the educational objectives that were shared by the participants were more related to affective considerations. These include intrinsic motivational factors, critical thinking dispositions, and affinity for others. This was especially noticeable in the class survey data; asked about important skills for developing higher-order thinking, eight of sixty-seven respondents cited the abilities of teachers to connect with their students, to see things from their perspective, to understand them, to listen well, and to empathize.

The following section reflects on the relevance of affective experiences, and their manifestations, to higher-order cognitive development.

Affective Dispositions

Psychologists have named a host of motivational and dispositional characteristics that relate to learners' progress in academic achievement. Of particular relevance are the motivation to engage in deep learning (including an interest in the metacognitive processes that facilitate intensive study of any subject), and the critical dispositions, which are sometimes referred to, collectively as "critical spirit." A third important affective aspect of pedagogy is caring, including moral and empathic consideration of the needs and the interests of others.

One teaching assistant referred to the importance of "willingness" in higher-order cognitive development; the instructors and the other assistants may have assumed that this was so obvious as to be unworthy of mention. Seven of fourteen students professed that intrinsic motivation is a highly relevant pedagogical factor in complex cognitive development.

The possibility of developing broad and deep thinking depends upon a personal commitment to achieving, over a lengthy period of time, a set of progressively more difficult (cognitive, metacognitive and affective) goals. Some university students are so disposed, and some are not. Deep motivation is manifested in a host of dispositional characteristics, including the nineteen types published by Facione and the APA Delphi panel; the respondents echoed many of those, and added several others that may also be considered useful (including enthusiasm, empathy, resilience, respect, patience and tolerance, all of which can be especially relevant to those in the teaching professions). It seems to be important that students understand the value of forming and maintaining the psychological and philosophical commitments that underlie the assiduous efforts that are required to develop and maintain a broad, deep, reflective and dynamic cognitive equilibrium. If students do not learn the value of deep motivation and the critical dispositions, or if they are not exposed to thinkers who can model the behavioural processes that are characteristic of these affective states, they can hardly progress in higher cognitive development. It is incumbent on their teachers not only to inform students of the great importance of these motivational factors, but also to demonstrate how they are manifested in action.

Student G named empathy, patience, and tolerance, and Student H specified respect and relatedness as dispositions that support teaching and learning complex and higher-order thinking; no other interview participant mentioned the dispositions that facilitate relating with others. This is an interesting finding; it is possible that the other respondents (in this case also) took for granted that interpersonal affinities are so highly relevant as to be already clearly understood by everyone; on the other hand, it might be that the disposition to relate well to others is not seen, by most educators, as holding much value when it comes to higher education.

The class survey data indicated that many of the students who were not interviewed agreed on the importance of morally supportive attitudes, including happiness, friendliness, caring, nurturing, loving children and loving life. It appears that these students experience their pedagogies as much from the emotive perspective as from the cognitive one.

It may be useful for teachers to adopt the approach that educational relationships are relationships first and educational second; we would do well to keep in mind that better relationships enable better education.

Methods

A plethora of instructional methods was recommended by the participants to support cognitive growth. Chief amongst these is dialogue (mentioned by the six teachers and ten students); the broad approach to subject matter (presenting alternative perspectives) was also well represented, as were questioning, and the general purpose of providing educational guidance.

It is important to note that not all discussions support the progressive development of complex cognition. While Students D and E remarked that the class discussions were very helpful for this purpose, Student F claimed that the conversations "went off on tangents," and Student M thought that they were not very useful. It seems that some discussions are more useful than others; the most progressive may be those which, according the schemes of discontinuous cognitive development proposed by Piaget (disequilibration followed by accommodation) and Mezirow (disorienting dilemmas followed by changing meaning perspectives), persuade inquiring learners to unlearn maladaptive prior beliefs. Demanding explanations, and challenging each other's assertions, may provide opportunities for transformative learning; as Instructor 4 explained at the beginning of the term, "This class is designed to get students used to different ways of thinking about education, to get them to think carefully about controversies in education, and hopefully in that way their critical thinking skills will develop, their educational assumptions will be destabilized. That's my goal … I want to destabilize their assumptions about education."

A number of other instructional design elements were named, which also seem to be relevant to cognitive development. Providing a safe psychological space for the class discussions seems to be especially important. Students may harbour fears about sharing their thinking in a forum where their views will be subject to analysis and evaluation; we are not always confident that our contributions will be valuable. We've all suffered from humiliation in life, and many of us are reluctant to participate, so the manifestation of a learning community where people are always trusted to take care of each other's feelings, and where the common goal is to share in the creation of new understandings, is extremely important when it comes to examining the justifications for our ideas, our actions, and our lifestyles. Progressive dialogues cannot occur where people are too defensive to share their ideas, exposing the sensitive roots of their beliefs. Future educational research might focus on determining what elements of group dialogues are most useful for supporting students in delving deeply into the justifications for the various alternative approaches to the issues that are discussed, and how the discussions can be structured to facilitate self-reflection, self-correction, and the progressive development of deeper and wider coherency. One useful trick that was mentioned in the interviews is the provision of contradictory ideas, or even false information, to get the students thinking about what makes sense and what does not.

Providing a variety of means to acquire and practice new discourses offers opportunities for students to learn in different ways. While some arduous methods may be well suited to support the cognitive development of dedicated professionals who are highly motivated, many undergraduates (apparently) have relatively low limits on how hard they are willing to work, and how much difficulty they are willing to endure in the process. Tailoring the methods to the learners, customizing our learning environments, facilitates greater educational progress.

Challenges

There was general agreement amongst the teachers that some students were unwilling to engage in the academic efforts that can result in higher-order cognitive development. Some students decline to aspire to goals beyond the curricular requirements. While some students were prepared to engage in complex ideation, many did not participate in deep analysis, and some lacked basic language skills; the instructors understood this, and realized that a lot of time in their courses would be spent on delivering basic materials and enticing their students to learn to think more broadly and deeply (despite some palpable resistance). However, some students found the work very difficult, wanted to be fed the correct answers, and failed to comprehend the material very well in the time available.

Four students found that the greatest challenge to higher learning was overcoming learner biases; however, three felt (to the contrary) that some learners are too open-minded, and accepted what they were told without enough questioning. Ironically, two of these three students also mentioned closed-mindedness as an obstacle. These are interesting observations, point to a lack of critical appraisals of the subject matter being presented. Uncritical acceptance or rejection of alternative views indicates a lack of commitment to justificatory processes; this is consistent with the teachers' idea that many students are not well prepared for such tasks.

A great deal of information is presented to students in elementary and secondary school, and they have been assessed on their abilities to absorb the ideas that their teachers wanted them to absorb. While some of them learned (from their parents, and from teachers whose lessons included cognitive objectives) that there is more to learning than understanding and remembering, others were mostly (if not wholly) concerned with activities aside from deep analysis, inference, evaluation and theory building. Without an appreciation of the value of doing those types of cognitive work, and without the deep motivation to understand complex ideas clearly, students can never prepare themselves to forego their intellectual laxity.

Those who do commit themselves to the difficult work seem to face another set of challenges. Even if they understand (as the teachers for Course 4 acknowledged) the need to recognize and acknowledge their biases (and those of others), they are still working in a system that (according to several students) does not support higher-order cognitive development. Student B felt that classrooms are not a very good place to learn thinking skills, and Student G agreed that "teachers don't encourage higher-order thinking," and thus it is "difficult to think independently in an academic context." Student M also agreed that the system of academic rewards encourages low-level learning. Besides, many students have never learned about higher-order thinking and they don't know how to deal with it (as Student C testified).

Some students manifested evidence of attachment to the notions of objectivity, and to seeking the truth of the matters under consideration. As Instructor 2 pointed out, these indications of dependence on philosophical absolutes (low epistemological sophistication) prevent learners from appreciating the complexities of framing our knowledge as contingent on our presumptive approaches to a subject. Educators are faced with the challenge of communicating the value of understanding contemporary views of epistemological certainty; students can learn that eschewing attachments to certain knowledge (abandoning their commitments to finding the "right answers") allows us to widen our cognitive perspectives.

Besides the cognitive challenges, there are emotional barriers to reforming our pedagogical practices. The two teachers from Courses 1 and 2, and Teaching Assistant 3, pointed out that asking people to examine their cherished beliefs might cause emotional discomfort; it is sometimes difficult to realize that our beliefs, and our habits of thought, have been more maladaptive than beneficial. This type of experience can prevent people from engaging in inquiries that are deep enough to affect the ways that we think, or from trading our less cogent ideas for others that can serve us better in the future.

The material is difficult; there is not enough time for everybody to think it through clearly (given their levels of preparedness for the tasks), and it can be very uncomfortable to learn that our current beliefs may suffer perilously from a lack of appropriate justification. It's no wonder that the results of undergraduate instruction in philosophy and psychology are far from consistently excellent.

Outcomes

All the teachers, and some students, reported good results; Table 11 lists a variety of favourable descriptions of effective cognitive work (including working hard and inspiring others). However, I received the impression, when asking about "remarkable" results, that the teachers were hard-pressed to cite examples. I was told that a few students excelled, a few performed poorly, and most produced average work. The few who excelled were apparently motivated and enthusiastic; they brought materials to class, did extra work, and inquired about opportunities to continue their work in these fields of study. Instructor 1 shared that some students had communicated long-term perspective changes in their appreciation and tolerance of other people, and increased awareness of their own ways of thinking.

The teachers reported that some students shared their satisfaction with the courses, and the student course evaluation reports confirmed that those in Courses 3 and 4 who wrote comments were very complimentary towards their instructors; these comments were highly appreciative of the teachers' work. While the course evaluations do not indicate the specifics of student accomplishment, the fact that these instructors earned such appreciation from their students seems to indicate that they did many things very well.

Most of the teachers remarked on evidence of improvements in their students thinking, including increased awareness of new possibilities and changes in their perspectives. However it appears that (while we may presume that most students manage to increase their stores of declarative knowledge), there was no evidence of great shifts in the cognitive perspectives of many students. On the other hand, at least one of the students whom I interviewed reported a remarkable change that resulted from learning about self-regulated learning.

> Coming in to this course I was never the type of person who regulated anything. I never had an agenda, I never had deadlines which I created for myself, I never proofread anything I wrote. I always did well, but now I'm doing even better, picking up on some of these tricks; set goals for yourself, and specify how you're going to implement your intentions, and follow through to achieve that goal … I think it starts with a general goal, and questioning yourself on how you're going to get to that goal. I know a lot of the emphasis in this course was on knowing your own abilities, and with that in mind, pushing those abilities, constantly working on them to grow and to develop your mind and skills. …And especially as a future teacher I would want to emulate those practices so that my students see how they should go about achieving their goals.

It is possible that similar breakthroughs in epistemological sophistication, critical thinking, and critical dispositions would be of use to any student that wishes to increase his or her cognitive capacities.

With regard to learning about higher-order thinking, the student interviews may be seen as lacking in evidence of deep comprehension of this topic. Of the fourteen students asked "What are the most important or interesting things that you have learned about higher-order thinking, learning about complex subjects, or solving difficult problems," eight furnished coherent responses, including one who mentioned that the journal writing assignment for Course 2 was superficial, and not suited for deep thinking. The closest anyone came to sharing a powerful insight about thinking was when Student D remarked,

> Sometimes I'd form an opinion about something, and then in class I'd think, what was my position before? And now why do I see it changing? … You draw upon your own experiences on a particular topic, and you realize it's so much different (because you come from a different culture), and no-one seems to agree, and then you learn about other people's experience of the same thing, and you realize the diversity of people, and you're just one particular player in that diverse universe.

This example demonstrates that at least one student recognized the value of broadening our conceptual frames.

Three students reported that they had improved their thinking, and four reported increasing their metacognitive activities. However, Course 3, educational psychology, which covered critical thinking, metacognition and self-regulation, may not have been very comprehensive in describing cognition; as Student I reported, “We didn’t really learn about thinking. We were always discussing everything in class, but we weren’t talking about how to think.”

The in-class survey provided more information on this issue. Forty-six students responded to the in-class survey question on what they had learned about thinking, and some of these remarks are informative, including those of one student from Course 3, who communicated, “I found that I have difficulty solving complex problems. That is, my ‘higher-order thinking’ capacities are medium to low.”

Two students from Course 2 pointed out that they had learned that there aren’t any right answers; this seems to indicate an increase in epistemological sophistication, a diminution of their desire for absolute certainty, and liberation from the difficulties of needing to figure out the correct answer to every difficult question. One student from Course 3 wrote, “There are infinite ways of solving problems, and each of them can be right … Therefore there are an infinite number of ways to learn …” While this may seem to be an overstatement of the conditions in any classroom, it does indicate a broadening of one students’ perspective on knowing and understanding. Another educational psychology student wrote, “Things are never simple and every situation is different, therefore the knowledge I’ve acquired needs to be applied in a very flexible manner”; this is a very useful lesson on the epistemic notion of contingent justification.

Several other students also raised some very hopeful notes, as, “when you put your mind to it you can do whatever you want; solving difficult problems means you think critically.” Also, one student wrote about learning complex material, “that it is really not as difficult as I thought it was to understand; just read it slowly, digest it and think about it." Another communicated, "When you are really able to dig your nails into something you thought was impossible [it] is extremely self-fulfilling." One person wrote that he or she learned, about higher-order thinking, "the profound effect it has on my concept of self and my belief systems. It triggers evaluation and re-evaluation."

On the basis of the above evidence, it is apparent that some students received some powerful messages about thinking that will influence their future cognitive development in favourable ways.

Perspectives

All six teachers, and ten students, shared their perspectives on pedagogical approaches to supporting higher-order thinking. Two instructors pointed out that it is important to consider the students' various viewpoints, and that every student can contribute value to a class by sharing their perspectives.

The students also shared a wide variety of pedagogical opinions; four pointed to the need to broaden our outlooks by considering alternative perspectives on an issue, and two underlined the importance of self-regulated learning. The lack of consensus on the students' part, with regard to the need for attention to be paid to cognitive processes and higher-order thinking skills, may indicate a general trend of institutional neglect; some students bemoaned the fact that they have never been exposed to any information on means for developing their cognitive abilities.

With regard to the pedagogy of thinking and of understanding, the participants shared a wide variety of opinions. Teaching Assistants 1 and 2 echoed the notion that critical thinking is not a well-defined skill, while Instructor 3 defined the idea as the "systematic organizing of ideas and strategies." None of the teachers put any faith in the notion of discovering true answers to complex questions; Instructor 1 said, "Each of us has our own ways of knowing what's true. I think that's what really gave [the students] the confidence to come out and speak their minds, or say whatever they wanted to say, and that kind of led to the creation of a safe space, where they could talk without fear of retribution." Instructor 2 thought that believing in truth is a barrier to cognitive growth, stating that a good student is, " … more willing to be open-minded about different ideas, than the student who is more of a believer in there's a truth and a non-truth. I could see evidence of that in the class; there were some students who believed that there was only one right answer … then you would see other students who looked at knowledge as a more infinite area. These students typically did better, of course." Instructor 3 remarked on teaching about the subject, "Do I think that I converted everybody to the idea that 'truth' should be a regulative ideal? I think some people might have thought more carefully about that after we were finished with that discussion." Teaching Assistant 1 shared, "Truth is based on perception.," and Teaching Assistant 3 said, "Personally I think that there could be multiple truths."

Many of the students whom I interviewed also demonstrated their epistemological sophistication in denying the value of the idea of epistemic truth; for example., Student B claimed, "I don't think there's such a thing as a true statement. I think it's relative, it's all relative." Student M said, "I don't believe in empirical truths, really; a lot of the subjects that you can engage with critically, those subjects, the reason we can engage with them critically is that there aren't that many empirical certainties." Student G claimed, "Knowledge isn't absolute, it's just a state of being, and it's temporary." Five students joined in the perspective that 'truth' is not what knowledge is about; four professed the opposite (more traditional) view of the subject, and five were confused or non-committal (or both) about the relevance of the idea of 'truth' in educational settings.

It is interesting to note that only four of the students were clearly enmeshed in the ancient paradigm, and that five were clearly aware that knowledge does not depend on the correspondence of our ideas to the one true reality. More information on epistemology (and its failure to demonstrate what is meant by 'true knowledge') could certainly be used to elevate the levels of epistemic sophistication of undergraduate students.

Teaching Assistant 1, Instructor 3 and Teaching Assistant 3 pointed to the importance of selecting course curricula that support the purpose of stimulating learners' cognitive development. Subject matter can be selected merely to provide information, but some sources perform that function in ways that are more thought provoking than others.

With regard to pedagogical styles for teaching students to think critically, the three instructors provided some interesting contrasts in their approaches. Instructors 1 and 2 hold opposing views; the philosophy teacher eschews the idea of describing cognitive skills, while the educational instructor provides information on critical thinking, metacognition and self-regulation as part of the course curriculum. Instructor 3 (teaching for the second year) voiced a commitment to the former (implicit teaching) style, but found that it was important to discuss the mechanics of cognitive operations, noting, "It wasn't quite as implicit as I anticipated it would be … I guess I did talk a little more deliberately about fostering higher order thinking than I anticipated, because I did not anticipate that people wouldn't do it."

Some students may learn to analyze deeply, and to pay careful attention to the ideas and the evidence that guide (and justify) people's actions, without specific instruction in cognitive processes. On the other hand, it seems likely that understanding how human cognition operates can facilitate our seeing what works better (or worse) in creating complex discourses, and in dealing with difficult problems.

Assessments

Teachers from all three courses remarked on their students' levels of engagement with the materials; unsurprisingly there were mixed results, with some lessons working very well in this regard (and some less so), and with some students manifesting their resistance in a continuing reluctance to be very actively involved in their own education. The area of individual learner differences is an important one in educational psychology, and a great deal of research has been (and likely will be) expended in the search for ways to make classrooms lessons accessible to students of all inclinations and dispositions; however, if students' preparation varies, then they cannot learn the same lessons. Everyone needs material that are suited to their current abilities to learn (their "zones of proximal development," in Vygotskian terms), and instructors need to figure out the means to present both basic and advanced material to their classes, in order that optimal benefits may be achieved by each student. Relating to the students' needs, and understanding their perspectives, is an important part of this process (an objective that was underlined by Instructor 2).

Students D and E pointed out that Course 1 and Course 2, respectively, did not deal with thinking, and Student I (as mentioned above) pointed out that the educational psychology class did not pay much attention to critical thinking processes. Students I and

K both pointed out that they wished they had learned something about thinking in school before they arrived at university, and that their earlier school experiences were deficient in not preparing them to apply their efforts to cognitive work. Student K went so far as to complain of the "dehumanizing" effects of learning in school, as, "I was told to sit down and be quiet and just do well on the tests. Which is why I don't think our education system is very good."

Yet, the student course evaluations indicated that Instructors 2 and 3 were exceptional teachers. One wonders what more education professors can do to enable greater proportions of their students to appreciate the benefits of learning to engage in complex and difficult cognitive tasks.

Learning Strategies

When asked about useful methods for teaching and learning higher-order thinking, Instructor 2 suggested the instructional strategy of identifying and restating key ideas. The instructors also suggested some strategies for learning (reading carefully, keeping a learning journal and creating concept maps). These are useful tips; and we might hope that more advice will be forthcoming to support future cohorts.

From the students' perspective, three agreed that they need to read complex materials very carefully, and that rereading such material (perhaps several times) is often needed. Staying calm, and talking oneself through the difficult parts, were recommended by two students; in total, seven suggestions came from two students of educational psychology (Students G and H), and four other students (Students D, F, J and K) contributed seven more; this may reflect the strong emphasis placed on self-regulated learning in Course 2. It seems likely that the lessons in self-regulated learning were useful to some of these students, and their insights such could prove useful to any learner who wants to learn to expand his or her capacities to learn to think broadly, deeply, and coherently.

Synthesis

In many ways, the findings from Study 2 reflect those from the first set of interviews. All of the topics were discussed at some point; however, there was very little work done in the areas of affective dispositions, metacognition, epistemology, or transformative learning. The philosophy of education instructors worked towards coherence without focusing on specific thinking skills (although Instructor 3 acknowledged the need to infuse some critical thinking instruction), and Instructor 2 covered critical thinking and metacognition in the educational psychology course. There was wide agreement about the need for higher reasoning, but little agreement about how to accomplish this objective. The three instructors reported a variety of results, including a few standout performances, and most respondents (teachers and students) who had an opinion about cognitive development indicated a need for students to be deeply engaged in their work.

The student interviews also demonstrated a variety of perspectives. While a few students had little to say in response to my requests to identify or recognize cognitive skills, and demonstrated little evidence of deep or broad thinking, others were obviously well versed in the practices of analysis and evaluation, and were able to describe their expertise with great eloquence. Some of the students I interviewed demonstrated keen insights, and some responded to probing questions about knowledge with relatively high epistemological sophistication (eschewing the notion of truth in favour of more progressive ideas about justification). Many of the 14 students demonstrated their awareness of the need for a wide variety of affective dispositions that facilitate learning.

Classroom observations and inspection of student work products confirmed that there are many topics that philosophers of education and educational psychologists can teach, and that the subjects of these four courses did not focus much on thinking skills or philosophy of knowledge. This stands in contrast to the wide agreement that students need to improve their thinking and advance their cognitive development, because metacognitive practices focus on improving our thinking by examining our it closely, examining our justifications, and correcting our ideas at every opportunity.

5. General Discussion

Research Questions

My investigation produced the following insights into the research questions that I have described (pp. 10-11).

I asked the theoretical question: *Which philosophical and pedagogical perspectives on instructional design and cognitive development are likely to facilitate higher-order intellectual development?* I found that a great deal of attention has been paid to the relevance of constructs from educational psychology. These include critical thinking, metacognition, self-regulated learning, motivation, and affective dispositions. Some educators have also stressed the value of transformative learning; all of these theoretical processes, and their various sub-processes, comprise subject matters that are essential to the understanding, and to the development, of complex thinking. In addition, I have described the notion of epistemological sophistication, which describes the depths of understanding that we can develop about the nature of understanding itself, and I have proffered Rawls' wide dynamic reflective equilibrium as a regulative ideal that is more useful to educators than that of epistemic truth. I have also mentioned the application of dynamic systems theory in philosophy of mind; this theory provides a means to understand thinking as a much more complex process than linear information processing. Finally, I described the ecological approach to educational psychology, which focuses on the creation of rich educational environments through the provision of educational affordances, including the development of the effectivities that students need to recognize and to exploit these tools.

What empirical research has provided useful guidance for teaching and learning the processes of higher-order thinking? A great deal of quantitative research work has been done to investigate variables associated with measures of critical thinking and self-regulation, and questionnaires have been used to investigate motivation and epistemological sophistication; however, relatively few qualitative studies have been published about the experiences of educators and students who are working on higher-order learning and development. Understanding teaching and learning processes is a matter of experience; while quantitative measures provide information about the results of educational interventions, they do not provide much information about the experiences of the individuals involved in teaching and learning situations.

What course materials, are currently being provided to education students in Canadian universities with regard to higher cognitive development? How do the course materials provided to Canadian education students relate to contemporary research in this area? I found that all of the topics that I have considered in my framework (p. 8) are being discussed in various education courses; however, the empirical evidence showed that classroom work on affective dispositions, transformative learning, and epistemological sophistication has not been emphasized as strongly as the subjects associated with reasoning and self-regulated learning.

What do Canadian university education instructors and students understand with regard to teaching and learning higher-order cognitive processes? I found a wide variation in students' and teachers' interests in the theory and practices of higher-order thinking and learning. While some instructors eschewed the notion of teaching about generalized cognitive skills (preferring to think in terms of better and worse subject matter mastery), and while some students did not demonstrate much awareness of the existence and the use of specific cognitive operations, other educators (and some students) were aware of, and were very interested in, the value of understanding thinking processes in order to develop their use through practice.

Limitations of this Research

The main limitation of this research is a limitation on the usefulness of the complex eempirical results and highly abstract theoretical models which have resulted, neither are easy for Education faculty, let alone schoolteachers to apply.

To summarize my findings in one sentence, I would suggest the following. Despite the best efforts of sixteen highly qualified and well-intentioned instructors of education, the results of their instruction with regard to their students' development of higher order and complex cognition have not (according to the instructors' own descriptions of their experiences) been spectacularly successful.

Whether we attribute the lack of greater success to institutional inertia, student resistance, or the difficulty of the tasks, is hardly relevant; a great number of educational forces and counter forces are at play. The dissensus amongst education instructors (what I metaphorically label as the paradigm wars, or the pedagogical wars), may be relevant to the problem; it is possible that undergraduate students are not interested enough in higher order thinking to succeed in developing much complex cognition, and it is apparent from the data that their early education has not prepared many of them very well for the challenges involved in higher cognitive self-development. Relatively few of them (according to their instructors) have been inspired to take on the task of cognitive self-transformation, and many were indisposed to do so. Results such as those reported here should be a matter for concern to educators (especially if they are judged as likely to represent wider trends).

However, it is widely understood that generalizing results gleaned from analyses of qualitative data, which were obtained from relatively small samples of education instructors and students, should only be attempted with extreme caution (if at all). Therefore, I acknowledge that the results of the analyses of the interviews that are reported here are not necessarily representative of all participants in university education departments.

The interview protocol used here was intended to educe the participants' experiences of the work that they did in their courses; it was not intended to gain precise information about learning outcomes. Other (quantitative or qualitative) methods, applied directly to assessing students' work products, are more suitable for judging outcomes, and no such method was attempted here.

Finally, in any study that relies on subjective reports, there is the possibility that participants may shade their responses to reflect the images that they would like to project. While it seemed to me that the participants were frank and honest in their reporting, the possibility remains that some of the reports may have suffered from this type of bias.

With the above disclaimers in mind, I nevertheless intend to provide inductive generalizations, based on the data reported, and also based on inferences drawn from the educational literature. With this understood, readers may evaluate for themselves, on the basis of their own experiences, whether the findings of this investigation accurately represent a large proportion of university courses in education.

Creating Pedagogical Frames

To conclude this project, and to define a context for future inquiries into pedagogies of higher-order cognitive development, it is possible to create conceptual models of the various processes that I have documented. Models of the interactions of the learning, and the teaching, processes involved in education can serve as useful guidelines for instructional design. They do not provide solutions to pedagogical problems; rather, they frame the contexts within which problems can be analyzed, and within which solutions to problems can be developed, applied and assessed.

A Context for Modelling the Learning and Teaching of Complex Subjects

The hyper-complex construct *higher-order thinking* refers to a set of processes where algorithms (rules of procedure) are not adequate for solving problems, and where absolute knowledge (true conclusions) does not apply. Instead, the cognitive processes involved in dealing with preconceived ideas (namely comprehension, analysis, and evaluation), and those that shape novel discourses (synthesis, explanation and argumentation), are bounded by general guidelines, which are mediated through social interactions (rather than by strictly preordained rules). The outcomes of higher-order thinking are hypotheses, rather than unquestioned truths; the former are more useful in furthering higher cognitive development than the latter (Baxter Magolda, 1992; Belenky, Clinchy, Goldberger & Tarule, 1986; King & Kitchener, 1994; Kuhn, 1991; Perry, 1970; Rorty, 1991; Siegel, 2006; van Goor et al, 2004).

Given the above context, an ideal model for the pedagogy of higher-order thinking cannot consist of a firmly fixed set of ideas, and rules for their relationships. Rather, we can furnish descriptions of the many processes involved, which operate simultaneously over time, and which are subject to influences that vary continuously. The (observed or potential) outcomes of these processes are manifold, and they are difficult to assess. The situation calls for a dynamic model of conditions, actions and observations, which describe learning environments, instructional activities, learners and pedagogical objectives (Barab & Roth, 2006; Baek, Cagiltay, Boling & Frick, 2008; Brown, 1997; Lee & Park, 2008; Spector, 2001; Winn, 2002; Young, 2004). In the following sections I describe three normative dimensions of learners' erudition, which characterize the potential for development of highly complex cognitive structures. I also present six pedagogical objectives for educators, which support higher cognitive development and academic achievement.

The three dimensions of learning, and the six broad instructional objectives, define possibilities for creating productive learning environments, using effective methods, and implementing the formative assessments that facilitate the development of highly competent thinkers. The objectives may serve as guidelines for educators to creating and implementing those elements of instructional design which support and facilitate students in monitoring, evaluating, and reforming their cognitive and affective processes. The three learning dimensions and the six objectives are based on theoretical literature, empirical literature, and the results of the current investigation; they combine contemporary ideas in education, philosophy and psychology with the discourses provided by the participants in the two studies reported above.

Three Dimensions of Learners' Development

The more we learn to deal with the philosophical and psychological vagaries of human understanding, the better we are equipped to develop wide, dynamic, reflective and coherent cognitive equilibria. To create a normative model of the characteristics of learners that enable higher-order development, I have described three normative dimensions, broad areas of self-development, which facilitate learning at advanced levels. These are (a) motivation/affect, (b) metacognitive self-regulation, and (c) epistemological sophistication. The implication is that the more a learner develops his or her competencies at self-regulated learning in these three areas of development, the more effectively one can develop highly complex networks of coherent ideas.

I. Developing Higher-Order Motivation and Affect

I have described two aspects of human personalities that I consider to be normatively associated with our abilities to manage successively more complex dimensions of thought. In particular, I have described two affective constructs as factors that contribute to the psychological potential for higher cognitive work. These are (a) critical spirit, our dispositions to learn (Facione, 1990; Ennis, 1987, 1998; Paul and Elder, 2002), and (b) moral virtue, caring for others (Noddings, 1984; Nussbaum, 1990). Here I summarize the potential benefits of developing the motivational commitments to create complex coherent networks of assumptions, concepts, principles, beliefs, and judgments.

The results from the current investigation support the need for learners to develop the deep motivation that leads to complex justificatory frames. There was a relatively high degree of consensus evidenced by the instructors on the point that many students were only interested in surface learning, and that these students were unprepared to learn the cognitive practices associated with higher-order thinking. Seven of 14 students interviewed stated that motivation was an important dispositional aspect of higher-order cognitive development.

Critical spirit describes the motivation to think critically, to analyze, evaluate, and infer as much as we can, and to synthesize our ideas and explain our justifications so that others can clearly comprehend the meanings that we infuse into our discourses. This construct has been described in terms of a series of sub-constructs, critical dispositions, and we have examined Facione's description of the ideal critical thinker, a paragon that manifests every desirable intellectual attitude. If we presume that people can learn to change our dispositions, then learning to manifest critical spirit, in all its repertoire of behavioural habits, represents one dimension of self-development that supports the higher-order resolution of complex subjects.

And, if there is any 'justice' in our education schools, faculties and departments, then ethics (theories of morality) and morality (guidelines for good and bad behaviour) can play an important role. While ethics can be a difficult subject to master (especially when philosophers try to sort out diametrically opposing extremist views), it is not difficult to understand at least one way to apply the topic to education; virtue ethics, which recommends that we work to learn to improve our individual characters, and our social behaviour. Virtue ethics promotes ongoing self-development, and many educators recommend lifelong learning; the two self-development processes work in parallel.

In particular, I have referred to the virtues that are spawned through caring for others, to the development of social interactions that are mediated through commitments to caring for the needs and the interests of others, as well as one's own. Noddings (1984) describes moral education as that which, "… enhance[s] the ethical ideal of those being educated" (p. 171). A good teacher " … must nurture the student's ethical ideal" (p. 178).

It is possible that an egoist can think deeply, and that someone who cares little for others can produce transformative breakthroughs in human cognitive endeavours. However, I maintain that the highest forms of human life ('flourishing') include caring relationships with our social partners, and I maintain that thinking which lacks this dimension cannot be of the highest orders.

At the very least, caring gives us reasons to work hard to think better; so that we can contribute our work more effectively to others. My personal philosophy of education holds that higher-order thinking includes consideration of the needs and interests of others; and it also holds that we share moral obligations to teach each other, and to learn from each other, as much as we can. Thus the commitments to provide moral support to others, and to live according to a coherent ethical ideal, facilitate the development of interdependent relationships, which include thinking together to create complex frames of communicable ideas.

Thus moral commitment, and the epistemological disposition to think carefully about what we understand (or are trying to understand), relate closely to each other. The more we attend to creating (in concert with others) clear and comprehensive understandings, and the more we commit ourselves to ethical virtues in the context of human flourishing, the more likely we are to expand our networks of (relatively well justified) complex ideas.

II. Developing Metacognitive Skills

Eleven of 14 instructors interviewed for Study 1 agreed that metacognitive development is an important educational objective with regard to higher-order thinking, and six of them discussed this topic with their students. Three of six educators interviewed for Study 2 mentioned that metacognition was covered in class, and five of 14 students agreed on this point. All six teachers mentioned that metacognitive skills are important educational objectives, as did 11 of the 14 students.

To develop complex systems of coherent thoughts, we need to discriminate between combinations of ideas that support our success (that is, flourishing) in dealing with the people and the things in our lives, and those cognitive perspectives that lead to less desirable results. My perspective on coherency includes the notion that people want to live well, and to deal with each other in ways that produce mutual satisfaction. The life of an egoistic outlaw may be consistent with a different set of presumptions, but I stand on the idea that social co-operation, and collective flourishing, should serve as common aims for most educators and their students.

To accomplish these aims, we need to learn how to think in terms of networks of coherent ideas (Rawls, 1999), for ideas that are inconsistent with each other, or are inconsistent with the collective aims of flourishing societies, cannot support the most successful cognitive and social development. While other-regulation is suitable for young children (or for adults) who have not managed to develop autonomous metacognitive self-regulation, the development of widely coherent systems of thought depends on constant metacognitive attention to the consistency and the applicability of the beliefs that underlie our affect and our behaviour. This is to say that successful thinking, a necessary prerequisite for productivity and satisfaction, includes monitoring and evaluating the cogency of our beliefs, and correcting ourselves when our ideas are inconsistent with our (most respectable) aims.

The subsets of cognitive processes that are directed towards regulating our thinking are the metacognitive (or reflective) processes: self-monitoring (observing our thoughts), self-evaluation (assessing the utility of our beliefs) and self-correction (changing our ideas or the ways that we think about things). These processes interact with each other, and also with our affective states, and with our actions. In social situations, all of these processes interact with the experiences and the actions of other people (and with the environment). This produces highly complex dynamic interactions of people, ideas, actions and things. Failure to attend to the consistency of our beliefs, or to the values which we manifest through our behaviour, results in dissonance, a maladaptive confusion that obviates the possibility of successful and satisfying relationships. The most effective and productive way to deal with learning in a complex and dynamic world is to attend (as constantly as we can) to ascertaining that our actions are consistent with our beliefs, and that our beliefs are consistent with each other, with the most reliable evidence, and with our most beneficent purposes. Regulating our thinking is the means for doing this; if we aspire to thinking complex ideas in coherent frames, we must develop and maintain our metacognitive skills beyond the levels of those who are less ambitious with regard to achieving wisdom.

III. Developing Dynamically Functional Philosophical Frameworks

In the previous section, I maintained that bad thinking makes for bad living, and that attention to good thinking enables the development of flourishing lives. However, while thinking straight is a tremendous advantage when it comes to living well, good thinking must be melded with beneficent social values in order to produce flourishing lifestyles. Therefore, the highest forms of life inculcate values such as morality, justice, beauty and joy into our ideational frameworks, and we must attend as closely to our values as to our ideas, if we are to ascertain that our reasoning channels our activities along productive avenues, which increase the benefits of living for others as well as ourselves (Child, Williams & Birch, 1995).

Of 14 instructors interviewed for Study 1, nine claimed to have taught topics in (or related to) epistemology, and two mentioned that philosophy of science was covered. In Study 2, four of six teachers, and six students, said that epistemology was covered in their classes. Yet, while five instructors from Study 1 said that understanding higher order thinking is an important learning objective, the notion of epistemological sophistication was not brought up as an objective by any of the respondents from either study.

With regard to moral dispositions, the idea of caring for others was not forwarded by any of the instructors; one student brought up the ideas of peace, love and social justice as important educational objectives where higher-order thinking is concerned. While it is possible that the other 33 participants took these ideas for granted (and might agree on their importance if specifically asked), it seems to me that ethical discourses should be brought forth more explicitly in education programs (especially in courses on philosophy of education and educational psychology).

Maintaining consistent philosophical frameworks entails continually articulating ideas, and creating activities, that are consistent with our declared purposes, while eschewing beliefs in principles that contradict our aims. The ethical ideals that we appropriate (such as doing good, and avoiding doing harm) serve as foundational notions, and our epistemic principles (such as a commitment to considering our inferences to be fallible) provide bases for dealing with human understanding. It is essential that we articulation our purposes clearly, for stating our commitments puts of our ideas, and our actions, in context. Saying what we will accomplish (creating more or less magnificent goals), and making and keeping promises to perform actions that are consistent with our beneficent aims, provides a regulative framework for our affective, metacognitive and behavioural development.

Intellectual rigour demands that we maintain our ideas in consonance with the most useful philosophical principles that we can learn. We can utilize the contemporary philosophical approach of deflating the idea of empirical truth, the notion that humans can prove what is real. I was very disappointed when, at the outset of my first university course in statistics, I was informed that scientific conclusions are always probabilistic, and never absolute; my quest for certainty prevented me from fully adopting this conclusion until many years later, when I studied philosophy. I eventually learned that two perspectives on the idea of "true" assertions are extremely important in human communication, and should be assiduously maintained, and that the oxymoronic ideal of "scientific truth" is not among them (Rorty, 1991).

We can, and we should, maintain our psychological authenticity, by acknowledging our experiences (our feelings, our emotions, our beliefs, and our thoughts), and we should communicate our experiences honestly to our social partners. This type of truthfulness is essential for authentic communication, the type that supports the needs and the interests of others as well as ourselves. Educational relationships, like any relationships, can be more or less communicative, and more or less authentic, and we can benefit more from authentic social relations than we can from those that include withholding, evading, or prevaricating. (Of course, this does not imply that we share everything; there are limits to everything, including the social benefits of being forthcoming. Discretion is also a social virtue.)

As a second useful application of the idea of 'truth,' we should recognize that languages contain "truth structures" (formal, or analytical truths), and that (like mathematics or logic) one category of 'truth' is carried through the definitions of symbols and operators (e. g., a bachelor is an unmarried man; one plus one equals two). The consistent use of language symbols is extremely important in human communication, and this is especially emphasized in academic environments. Twisting our linguistic meanings beyond recognition, using language falsely, is a form of equivocation, a fallacious method of argumentation, which obviates the possibility of coherent justification.

Finally, we can take heed of contemporary philosophers' warnings that empirical "truths," those seemingly certain conclusions that are supposed to be based on observed evidence, are consummations that we should avoid. Centuries filled with scientific breakthroughs, where the most recent set of "truths" have invalidated the previously accepted set, time and time again, have provided important lessons for inquiring learners. Empirical "conclusions" are based on uncertain hegemonic and paradigmatic presumptions; we have no warrant for claiming that our assertions about empirical relationships are absolutely true. They may be self-consistent, they may be consistent with the observations of more than one person, and they may be credible to a large number of highly informed and experienced analysts; some ideas are lead to highly reliable predictions of future events. Even so, deep understandings of epistemic considerations, purveyed by many expert philosophers, have indicated that our inferences are best regarded as contingent and fallible. This implies that, in order to engage in effective and socially practical activities, we should always allow for the possibilities of reconsideration, recontextualization, and (perhaps even) invalidation of our current perspectives on the world (Mezirow, 1991)

In consideration of all of the above, I consider that those who work to understand how we think, who willingly explore the intricacies of human comprehension, and who constantly deal with the social dynamics of moral considerations, can develop more advanced (wide, complex, coherent) cognitive schemes than those who are uninterested in cognitivism, epistemology, and ethics.

Six Pedagogical Objectives

I. Develop Motivational and Affective Dispositions for Cognitive Work

The pedagogical relevance of the affective and motivational states of learners is well recognized. Our desires, interests, feelings, attitudes and tendencies drive us to learn some things, and prevent us from learning others. We cannot force people to learn, or to change; we can invite, we can entice, we can reward, but anyone who is capable of higher order thinking (that is, who is wilful enough to take on the task of understanding complex sets of coherent ideas) is more interested in some things than others.

As indicated by the empirical evidence (summarised on p. 245), some students are only interested in surface understandings; many undergraduates are in school in order to complete a series of tasks and then to graduate. The intrinsic motivation that inspires deep learning appears to be a basic requirement for higher-order cognitive development, and this drive is not manifested in everyone. Some will not expend enough effort to expand their thinking beyond their personal levels of tolerance for complexity. It is useful for these students to understand this about themselves, and also for them to know that their instructors understand this as well. Higher-order thinking is not a problem for these students, since it is not their goal; their motivation levels will limit their achievements (Biggs, 1985; Boekaerts, 1995; Pressley, 1995).

Deep motivation to learn is enacted through a series of dispositional characteristics, which apply to individual habits of behaviour. These can be measured, and it is possible that we can learn to develop these habits (and these dispositions) even in adult life (provided of course, that we are motivated to do so). The propensity to ask questions, and to challenge authoritative conclusions, indicate the willingness to delve beyond surface comprehension. The commitments to perseverance in thinking through problems, to intellectual diligence, to flexibility, and to open-minded consideration of opposing views, exemplify the attitudes that enable us to deal with complex ideas. Dispositions to clarity, precision, reasonable justification, and relevance impel us to organize our discourses into coherent sets, and to relate these sets to each other in useful ways. The disposition to communicate enables social co-operation on educational development (Ennis, 1987).

Higher-order learning requires the acknowledgment, and the management, of our affective states; affective self-regulation is a necessary component of advanced learning. We can learn to be aware of our feelings and attitudes about learning tasks and goals, and we can clarify our understandings of our abilities and our limits. Awareness of our motives, desires and feelings plays a large part in learning; promoting our learning objectives above other goals, and using strategies to manage our counter-productive experiences, are also useful practices. Reflecting on our affective reactions, and our attributions of these reactions, can help us in dealing with future instances of these experiential complexities. Learning can sometimes be a painful experience; while it is hoped that the benefits of the experience are greater than the discomfort involved, great strides in understanding sometimes come at the cost of prior beliefs, which may fail to stand up to critical analysis of their foundations and their consequences. While critical investigation sometimes leads to painful revelations, we may nevertheless benefit from the transformational results of cognitive restructuring (Mezirow, 1991).

The commitments to provide, and to receive, mutual benefits through educational relationships increases the possibilities of flourishing throughout our lives. The qualities of the social relationships between learners (including instructors who learn) can be more or less facilitative of the educational process. Affinity for our social partners makes co-operative efforts more likely, and the creation of productive learning environments calls for mutual respect and the willingness to communicate effectively.

II. Accommodate Dynamic Complexity

None of the teachers or students interviewed evidenced any familiarity with complex dynamic systems theory. If any generalization is warranted here, this would indicate that the value of this theory has not yet been appreciated by a large proportion of educators. Since this perspective is beginning to emerge in many areas of academic work, we may hope that, in the near future, more educators will appreciate the importance of this paradigm.

Developing higher-order thinking involves increasing the complexity of our ideational structures, while maintaining their coherency. Recognizing the dynamical character of interactions of ideas, feelings and actions allows for understanding these interactions in ways that support higher-order analysis and deeper comprehension (Lewis, 2005). Higher-order learning entails expanding the limits of our tolerance for dealing with complex interactions of people, ideas, and events; and it includes applying our understandings of these complexities to our practical (performative) goals.

Higher-order cognitive development entails handling greater and greater levels of dynamic complexity, in an unending succession (because higher-order thinking is not completed once a conclusion has been reached). Conclusions (or "conclusions") are considered to be contingent, fallible and provisional, and progressive development occurs through coherent syntheses of more and more subjects and their inter-relationships. Narrow and static cognitive equilibria may be coherent (in the absence of new information); but we may widen our networks of coherent conceptions, by rearranging our perspectives with an eye to new openings (new questions, rather than answers).

Thus, broadening our cognitive perspectives consists of thinking-together different theoretical frames, which are not commonly associated, to gain insights into a subject (joining frames together, in addition to expanding each of them incrementally); multidisciplinary and interdisciplinary approaches illustrate this idea. Deepening our ideas is characterized by thorough explorations and examinations of the justifications (evidence, arguments and assumptions) that support the various interpretations of a situation. Combinations of these processes result in expanding our sets of coherent ideas (creating a wider dynamic reflective equilibrium) by increasing the complexity of our considerations.

It is useful to understand that the dynamic systems theory of cognition demands that we presume to relate many conceptual dimensions with each other (Franklin, 1995; Globus, 1995; Clark, 2001); the depth and breadth of our thinking each may expand in many directions (perhaps all at once). Thus while thinking seems to occur in a linear sequence of steps through successive moments of time, the sequence of ideas along a "line" of thought meanders through various interrelated cognitive perspectives (each of which relates many ideas) in more than one direction. Higher-order thinking is concerned with bracketing the various perspectives (defining their limits and the extents of their relationships with each other) to describe the coherent (and identify the incoherent) areas of the interrelationships of ideas.

Understanding cognitive processes, complicated as they may be, provides access to our mental faculties (metacognitive spaces; understanding our thinking). Comprehension allows for primary categorization of novel ideas, relating them to prior knowledge. Interpretation enables the integration and refinement of subject materials (also in accordance with previous understandings); analysis, synthesis and evaluation produce new assessments and judgments, which determine the relative value and applicability of our ideas and actions. The creation of new ideas, arguments and explanations provides for communication of the results of our musings. All of these processes operate simultaneously, organizing countless bits of information in coherent linguistic forms; an appreciation of the dynamic complexity of these processes is an advantage, if we intend to create wider and wider frameworks of coherent ideas (Rawls, 1999).

III. Specify Cognitive and Metacognitive Objectives

As described on pp. 247-248, there was fairly wide agreement in the results from both Study 1 and Study 2 on the importance of learning to practice metacognitive self-regulation.

Education is not only about deep and broad thinking. Children need to learn to communicate; cognitive abilities increase as learners mature. As we learn more and more language, identify more and more objects, and speak with more and more people, we gain more and more surface understandings (definitions, and direct relationships); we also begin to understand that things are not necessarily as they seem to be. The possibility of delving into descriptions of what we cannot see, or of transforming our received knowledge of the things we have known into different understandings (by applying different approaches to defining and relating our ideas), enables us to expand the limits of our thinking, to discover new possibilities for thinking, for understanding, and for relating with each other. We can continue to accept, and to purvey, the ideas that we learned from our elders without questioning the presumptions (or the evidence) on which they are based, or we can analyze and evaluate these historical perspectives in the light of the other ideas and evidence which become available to us. Diligent examination of our habits of thought can lead to clarifying and expanding our conceptual schemata.

Basic education precedes higher-order cognitive considerations. We need to be exposed to many ideas, and their social contexts, before we can analyze and evaluate them in relation to each other; this is accomplished through exercising basic language skills. Reading and conversing (and, eventually, writing and explaining) develop incrementally, but we can implement education with regard to cognitive goals even in the early years of children's lives. Lipman (2003) points out that lively, curious and imaginative children are stultified through exposure to rigid educational structures and disciplines; he recommends instead a "reflective paradigm of critical practice" (p. 18). Rather than transmitting knowledge from authoritative sources to absorbent minds, teachers can create communities of inquiry, where the teachers' ideas are considered to be fallible (*not* authoritative), and where, "Students are expected to be thoughtful and reflective, and increasingly reasonable and judicious ... The focus of the educational process is not on the acquisition of information but on the grasp of relationships within and among the subject matters under investigation" (Lipman, 2003, p.19).

Thus, according to Lipman, while acquiring declarative knowledge is certainly an essential part of education, the focus of education may be the use of this information (and not simply its attainment). Educational value is created through specifying the limits of our understandings, and through assessing the practical values of applying our ideas in various contexts. Thus we can teach *for* critical thinking; this requires fostering cognitive skills through dialogical practice, applying criteria, co-operative reasoning, and focussing on specific problems. These cognitive objectives enable us to practice, and to strengthen, our habits of thought so that we can expand our dynamic and reflective conceptual networks through co-operative educational interactions.

Specifying cognitive objectives (such as analysis, evaluation, inference, explanation, and argumentation) may be counted as teaching *about* critical thinking rather than *for* it, but (in order to practice these processes) students should be aware of their utility (Sternberg, 1987, 2001). Younger, and less experienced, students need to learn about these processes if they are to learn to regulate their own thinking, and to grow their abilities through self-regulation (a product of other-regulation, scaffolding by experienced teachers; Brown, 1997).

Experienced instructors (and many of their students) are clearly aware of the value of specifying cognitive faculties as a target for educational interventions. The skills involved include: analytical thinking, creative thinking, abstract thinking, considering alternative and hypothetical approaches to problems, creating clear explanations and cogent arguments, and synthesizing coherent conclusions. Perhaps most importantly, students can learn to implement the metacognitive processes of reflective self-monitoring, self-evaluation and self-correction. All of these objectives can be described; they can be modelled, they can be scaffolded, they can be practised, and they can be assessed.

Students can learn to form commitments to deep, broad, coherent thinking and to metacognitive self-regulation, but they are unlikely to do so if they are unaware of these processes and of the intellectual benefits that they can provide. Elementary and high schools can begin to prepare students for higher intellectual pursuits; however, if learners have not accommodated these processes by the time they reach university, they might never value the affective commitments that enable the development of higher and higher-order frameworks of conception.

IV. Create Supportive and Facilitative Learning Environments

The settings in which learning occurs can be more or less supportive of students' well being, and more or less facilitative with regard to developing complex thinking.

Instructors can create (in concert with co-operative students) environments that allow for students to experience a wide variety of feelings and emotions, and still feel safe enough to engage in pedagogical interactions.

Instructor 1 in Study 2 mentioned the need to create a learning community in the classroom; two instructors from Study 1 also professed this aim. Three instructors from Study 1 mentioned the importance of creating a safe space for communication in their classes; in Study 2, this idea was strongly emphasised by Instructor 1, and was also described by Student K.

To transform learners from passive vessels to reflective, generative and inventive participants in their own education, instructors can foster the development of a classroom community, a community of learners (as recommended by Brown, 1997). For Brown, this includes implementing progressive discourses, which include querying and criticism, at all levels of education. Instructors can share big ideas, describe deep principles, create higher and higher levels of abstraction, model higher order thinking and self-reflection, ask students for justifications, ask them to summarize what's known, and help set new learning goals. They can be available, and they can seek out opportunities to provide educational support. Peers can work together to learn from each other; in some cases, older and younger students can also use cross-age teaching techniques (which help the older children develop independence and responsibility). Instructors can emphasize the active and strategic nature of learning, and the needs for reflection and collaboration (to enable deep consideration of various perspectives). Interdependent activities promote joint responsibility, mutual respect, and the formation of personal and group identities, all of which enable further learning.

When it comes to the creation of learning environments that are rich with supportive educational materials, instructors can benefit from implementing flexible methods of instructional design, which are facilitated through comprehension of the ecological perspective (Young, 2004). We can develop our instructional techniques in the contexts of dynamic interactions of complex systems, manipulation of affordances, development of effectivities, attunement of our discriminative faculties, and the differentiation of adaptive and maladaptive actions. In this context, emphasis can be placed on individuals' relationships with particular learning goals (adoption, engagement and outcomes), and on manipulating (or modifying) the environments in which teaching and learning activities occur. Instructor responsibility is enhanced when educators understand that they and their students are interdependently co-accountable for the conditions that determine the success, or the failure, of their attempts to guide and facilitate pedagogical outcomes.

In order to create supportive learning environments, instructors can attend to the ethics of caring (Noddings, 1984; 2002), and to the collaborative and progressive development of the moral discourses that describe the values that are manifested in our activities.. In *Educating Moral People,* Noddings (2002) points out that teachers *must* "try to be good … and respond to suffering with concern and compassion" (p. 127). They *must* care for their students. It is also necessary, according to Noddings, that matters of moral interest be considered in conversations between teachers and students. And, "Perhaps most significantly of all, we are aware that our partners in conversation are more important than the topic … When people have loving regard for one another, they can engage in constructive conflict" (Noddings, 2002, pp. 127-128). The best teachers manifest caring behaviour, reaching out to communicate with each student, to understand each student, and to learn what will support these individuals *as individuals.* Teaching includes relating, and just as there is no single formula for successful relating, teaching is less effective when it is carried through rigidly established procedures. Just as flexibility (and diligence, and perseverance) are traits of competent learners, they also reflect the characteristics of caring teachers.

The willingness to learn how to communicate with a student, and to learn how he or she learns, marks a very important distinction between excellent and mediocre (or poor) performance in our educators. This seems to be especially relevant with advanced learners, when dealing with complex subject materials. Teachers can come up against the limits of their competencies in working with their most "difficult" students (those who question them the most, and those who challenge the teacher's authoritative assumptions and prior conclusions). Just as some students fail their courses of instruction, teachers also may fail in dealing with some students. The reflective practitioner is willing to learn (Brookfield, 1995; Cranton, 1996; Schön, 1987).

Instructional tools do not make an instructional environment; educators and their students do that together. We can create conditions that inspire, stimulate, and maintain the affective reactions, the dispositions, and the individual motivations, which enable a lifetime of inquiry, of learning, and of teaching others what we have learned. However, in order to do so, we must attend to everyone's emotions, needs, desires, interests, dispositions and commitments. This may be the most difficult part of teaching and learning, but its importance seems often to have been diminished, or overlooked altogether. Boler (1999) points out that the "pedagogy of discomfort" applies not only to students who face difficulties in detaching from maladaptive belief structures, but also to educators who face difficult pedagogical situations.

> Any rigid belief is potentially "miseducative" … [O]n a daily basis students may challenge me to question my own aims, ideas and assumptions. I frequently encounter my own defensive anger and fears … I am often tempted to dismiss views that I don't want to hear. Listening is fraught with emotional landmines … I perpetually re-evaluate and struggle to develop a pedagogy that calls for each of us to be responsible. (Boler, 2002, p. 179)

In adult and higher education, learning environments can be structured in ways that not only support incremental increases in our understandings, but also facilitate transformative leaps in cognitive development, which are associated with sweeping changes in our ideas through deep insights into our personal situations. As Robert Boyd (1989) described,

> [T]he social system can contribute in five ways to an individual's personal transformation. First, it can be a representative symbol of an archetypal element or principle. As such it can bring to light the archetypal component of an individual's personal dilemma. A second contribution is made in the phase development of the social society, which provides opportunities for individuals to reexamine resolutions of corresponding stages in their life course development. A third contribution is the supportive structure that social system can provide for experimentation, exploration, and disclosure, basic to the realization of personal

> transformation. Fourth, social systems contribute as the setting for projections. The awareness of one's projections is frequently the first major step toward one's personal transformation. Finally, the transactions taking place in the context of the social system reveal insights into the dynamics of personal dilemmas. It is such expanding consciousness that contributes to personal transformations (p. 469).

We can create learning environments that facilitate the continual, and sometimes transformative, growth of our cognitive frameworks, our dynamic networks of coherent conceptions. To do this we must attend to as many pedagogical possibilities as we can envision, collectively created and sustained through open communication in a psychologically secure environment, maintained by a community of supportive co-learners.

V. Apply a Rich Variety of Instructional Methods

The evidence from the two studies reported here indicates that some instructors are concerned with providing several methods, and a variety of affordances, in their classes. However, some restricted their activities to lecture and discussion (with occasional insertion of audiovisual materials), and educational technologies were not widely. Only one class made use of online discussions, and this tools was (according to the reports) poorly exploited. While we cannot conclude that this sample represents a other education courses, it is important to confront the possibility that most instructors have as yet failed to implement available technological tools to facilitate the progressive discourses that enable peer support in higher cognitive development. It is well known that students of medicine and law form study groups to support each other in the learning of complex ideas; educators should be aware of the value of peer interactions in this context, and should use every means available to facilitate such interactions.

While engaging students in cognitive work that facilitates deep, coherent, thinking can enable academic achievement, most undergraduate courses also require applications of teacher-centred methods. While the most advanced courses of instruction may specify that students gather information entirely on their own, most educational interventions include presenting information on the subject matter that is to be considered. Texts, lectures, videos, and other media may be suitable for information presentation, and the most basic university courses may consist of little else (without allowing much room for novices in a field of study to challenge the beliefs and the assumptions of experts in the subject area). This depends on an instructor's commitments to facilitating discussion, engaging in controversies, and allowing students to create novel perspectives. Some courses are not designed to permit the students much latitude for criticism or creativity; some instructors may prefer the traditional model of education: the transmission of information to absorbent student minds. It is difficult to design instruction for large introductory classes that allows much latitude for deep discussions, as there is usually a great deal of material to be presented and little time for extended analysis by inexperienced students. In these courses, small-group tutorials can be designed to handle questions about the material, and to foster critical analysis through progressive discussions. Of course, individual tutoring by an experienced mentor may be the most instructive (and most-student-centred) of any method for facilitating higher-order learning; in the absence of this luxury, mentoring by more experienced peers can also be effective. Peer support and study groups are invaluable educational methods for higher learning, as has been demonstrated in medical and law schools around the world.

Of course, discussions can be more or less broad, deep, or analytical. A moderator's experience in facilitating cognitive work (as well as his or her experience with the subject matter) determines the courses of the discussions; a skilled teacher asks challenging questions, demands justifications, and encourages people to participate actively. Dialogue, including the Socratic method of deep inquiry, stands as an effective method for stimulating thinking, and for expanding our cognitive frames, but conversing about our opinions is not adequate for this purpose. Sharing ideas is only the beginning of the process; discussions that do little else are inadequate for facilitating cognitive development. While the presentation of facts and ideas is an essential part of educational processes, higher-order thinking demands active inquiry, deep analysis, and the synthesis of antithetical perspectives. The presentation of conflicting and controversial ideas, leading questions, analysis of evidence and its relevance, and the presentation of coherent arguments promote progressive dialogues, discourses that can lead students (and their instructors) to newly created frameworks of coherent ideas.

The last process, creating argumentative discourses, is especially relevant. After we ask all the questions we have thought of (and before more arise), after we have considered the subject matter from various perspectives (if we have managed to do that), and after we have thought as deeply as we can about an issue, we must (if we are communicating in scholarly ways) create our own discourses, explain our considered opinions, and present our justifications for the inferences and the evaluations that we manifest. This is the social aspect of higher-order thinking outcomes, the possibility of contributing our views to others in useful ways. Learning communities progress when (on occasion) scholars influence each other through their work products. People can create transformative breakthroughs in thought, and lead their colleagues to new theoretical paradigms; this can only occur through deep analysis of controversial issues, the work of those who are committed to higher-order cognitive development.

In the terms of ecological psychology, a rich learning environment contains many and various affordances that facilitate educative interactions with texts, objects, devices and people. However, instructional methods and techniques do not make learning experiences; the people who are using the methods, instructors and students, can use them in more or less effective, and more or less progressive ways. The results of applying teaching/learning methods depend largely on the commitments of the participants, including the congruence or incongruence of their respective objectives, and their willingness to experience their experiences together. Committed learners, who are working together towards achieving common objectives, are more likely to produce better results than those who are not so aligned, especially if they have adopted the critical thinking dispositions, practiced their critical skills, have realized the pitfalls of attachment to finding the truth, and understand the benefits of discarding maladaptive beliefs. Instructors who have shared in these experiences are well qualified to design learning environments, and to apply particular methods, in ways that inspire their students to create their own paths to higher-order thinking, transforming their cognitive frames to accommodate all manner of new information.

Of especial importance are the methods that include practising the cognitive processes that are crucial to dealing coherently with complexity; instructors can explain and model these practices for the benefit of those who are paying attention and willing to learn. These include applying epistemic rigour, exemplified by commitments to a) bracketing our discourses by acknowledging the assumptions under which they operate and the conditions under which they are considered to be operative, and b) considering all of our inferences to be fallible. It also includes analyzing thinking (metacognitive considerations) in the context of epistemic uncertainty: how do we know what we think we know? Who told us, why did they tell us that, and on what basis did they create their discourses? How do these perspectives apply to our activities; are they beneficial for our future practices (and what are the limits of these benefits, and the counter-influences)? Understandings can always be deepened and broadened, if they are not discarded due to lack of justification; the infusion of critical and epistemic concerns is essential to teaching for the development of higher-order frameworks of conception. Furthermore, students can learn these methods, and apply them to their own thinking, and they can apply them in conversations with each other.

Aside from presentational and dialogical methods, many styles of teaching have been developed to support students in shaking off the fetters of basic instruction, transforming themselves from passive recipients of experts' beliefs to self-motivated, inquiring learners who are committed to thinking about things as well as human beings can think, and to understanding many things very clearly. Specifically, recent work in instructional design has produced a series of methods described variously as inquiry-based, problem-based, anchored, or authentic means of instruction. These include technology-based problem scenarios (including simulations and case studies), as well as face-to-face methods (such as role-playing, debates, games and competitions); they have in common the creation of ill-defined problematic situations, which relate to the subject matter under consideration, and which resemble those that are encountered outside of classrooms. They also include forays outside of class (from field trips to internships, and student teaching assignments). Such methods are invaluable for expanding our cognitive repertoires; the affordances that they present for interactions that result in higher-level cognitive work go beyond those that are available in presentations and classroom conversations. They provide opportunities for students to learn to develop the effectivities that will enable future exploitation of extra-curricular opportunities to expand and to deepen their understandings of their work.

Learning new things is not the end of cognitive development; it can be the beginning of future restructurings of our frameworks of beliefs. If we learn new ways to learn, then we can learn more and more. With regard to learning new ways to learn, the use of educational technologies has expanded greatly since microcomputers have become widely available. While the empirical work presented here revealed little use of computer tools in the education courses surveyed, the literature has demonstrated that many educators have great hopes for a wide variety of computer applications, each of which may be applied in various ways. Adaptive and intelligent tutoring systems may eventually provide affordances for a great deal of advanced learning. Programmed instruction, and computer simulations have been very successful in the education of those (such as astronauts) who must learn to deal with a great number of complex operational systems simultaneously. Synchronous and asynchronous forms of computer-mediated education have been successful in distance education and as supplements to classroom work, but we must keep in mind that educational tools alone do not determine educational outcomes; more important are the social contexts in which they are implemented, the ways in which they are used, the objectives to which they are applied, and the motives of the people who use them.

The more affordances (from supplementary reading lists, relevant movie titles, worldwide web links, computer applications, visiting lecturers, games, off-site activities, etc.) a learning environment provides, the more likely it is that students of varying experiences, competences, and inclinations (motives, styles and dispositions) will learn. A rich learning environment not only contains a variety of affordances, it can continually expand its store of educational materials and activities. Since students are prepared to learn according to their experience and their inclinations, the broader the variety of materials, and the more ways that we can provide to interact with them, the more likely it is that they will manifest their own interests and engage in the processes. Since student engagement is prerequisite to educational achievement, it is appropriate to make our educational environments as varied as we can, and to redesign them as necessary, even as we go along. We cannot always predict in advance the methods that we will need to use to reach our students in ways that will kindle their willing, or even enthusiastic, co-operation in our courses of learning and teaching.

VI. Evaluate Cognitive Outcomes

According to four of the instructors interviewed for Study 1, university courses are not designed to facilitate higher-order thinking; there was general agreement among all respondents in both studies that course time is limited, and that students want to get the right answers and the good grades. There was also a general consensus that many students are unprepared to confront the qualities of their cognitive skills. Thus, depth and breadth of thinking seem hardly to have been emphasised in the undergraduate courses that I sampled; this is consistent with the participants' reports that secondary schools do little to communicate the need for understanding cognitive processes.

For instructors to facilitate cognitive complexity, they must not only understand and practice higher-order thinking, they must also attend to each student's development with regard to the relevant learning dimensions (including epistemological awareness, cognitive and metacognitive skills, and affective dispositions). Students must also learn to attend to the various factors that contribute to each of these dimensions, and the most effective teachers will cue their students to recognize instances of successful or unsuccessful practices. A continual series of formative assessments can be created, with regard to the thinking that produces students' discourses, including success or failure of justification, presence or absence of critical analysis or self-monitoring, and the manifestation or lack of manifestation of the various motives and dispositions that lead to advanced achievement.

While there are standard questionnaires that provide operational measures of many of the pedagogical factors involved, it is impractical for teachers to make much ongoing use of these instruments (which are generally both specialized and unwieldy). However, motives, dispositions, epistemological sophistication and critical thinking can be measured with standardized instruments, and some instructors might find it useful to use such instruments as baseline measures, so that each student can be aware of his or her inclinations (to aid their self-regulative development), and so that the teacher can be aware of their students' individual predilections for complex cognitive work. Future applications of psychometrics, and of using technological tools to support formative assessment, may be designed to facilitate learning and teaching.

Teachers can monitor student participation ongoingly, acknowledging how the learners are thinking at each step along the course of instruction, and supporting them in moving towards the recontextualization of their most maladaptive ideas, and towards the synthesis of conceptual frameworks that will provide lasting educational benefits, in whatever field they are studying.

Future Research on Pedagogies of Higher-Order Cognitive Development

Since the current project, and the educational literature, demonstrate a wide variety of theoretical approaches to thinking skills instruction, and since a great deal of effort is being expended on research in various areas of education, it seems that the qualities of future research should be emphasized (rather than questioning how much research is being applied to this or that research topic). The question is how researchers can be directed to produce research of high quality, research that can be effectively integrated into the voluminous *corpori* that comprise the information that is relevant to all of the popular research questions.

Any research question may initiate inquiries that are well or poorly carried out and reported. Just as the manner of application of an instructional method is more important than the selection of the method (since any method may be applied more or less effectually), the manner of execution of a research project is more important than what is being researched. Thus (for example), researchers should be aware that reviewers of quantitative studies benefit from detailed descriptions of the methods and the contexts (*study features)* that accompany experimental interventions, and that standard measures of central tendency and variability are essential if coherent interpretations are to follow from reported results (Sternberg & Grigorenko, 2007). Similarly, purveyors of qualitative research studies should attend closely to the requirements and the pitfalls that attend the production and the interpretation of textual, observational or other qualitative data, and they should take appropriate measures to optimize the quality of their products (Denzin & Lincoln, 2005; Johnson, 1997; Lincoln and Guba, 1985; Rubin, 2000).

Deep understandings of educational processes can only be attained through intensive explorations of the experiences of those who are involved in learning and teaching; we can learn about the nature and the effects of these processes from qualitative inquiries that produce autobiographical material, narrative writing, interviews and observations. Interpretations of qualitative data gleaned from field studies are invaluable to anyone who wants to gain insights into what works and what doesn't work in various pedagogical situations. Qualitative (and mixed-methods) research is essential to educators who intend to deepen and broaden their understandings with regard to the ideas, methods and practices that support and facilitate higher-order cognitive growth, and these types of research studies should be encouraged ands supported by policy makers and funding agencies. If enough research is accomplished, and if the results are well publicized, then more and more educators will become aware of what can be done to design and implement courses of study that will emphasize ways to develop and maintain coherent frameworks of complex ideas. Sociological research into the creation and maintenance of educational policies would contribute to our understandings of what needs to be done to move institutions towards implementing curricula and pedagogical practices that are designed to support and facilitate complex and dynamic cognitive development.

Similarly, studies of institutional change in establishments that fund, and that deliver, "higher learning" may provide administrators with insights into what can be done to improve practices within their purviews.

Educators can establish thinking skills objectives, and we can assess the results of interventions that are designed to promote higher-order cognition and affect (including metacognition, self-regulation, critical thinking, critical dispositions, epistemological sophistication and ethical discourses). Managing changes to traditional curricula can be difficult; resistance to change is inevitable when established processes are challenged. Nevertheless, given sufficient time, and given adequate support and training (along with evidence that new techniques are well warranted), education professionals will develop wide dynamic reflective cognitive schemata with regard to pedagogical theories and practices, and future generations of students will benefit from their instructors' expertise in the philosophical and psychological factors that contribute to higher cognitive development, individual flourishing and harmonious social interactions.

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Appendices

Appendix A. Study 1: Interview Summaries

Interview A-1. Educational Psychology (~240 students, 1 semester)

This professor is not an advocate of the value of articulating or teaching stand-alone CT skills, but presents the theory nevertheless, along with the critique that cognitive skills depend on the subject matter. "I'm not sure that there are independent critical thinking skills apart from the subject matter … [M]y view on critical thinking is to have people immerse themselves in the subject matter, and that critical thinking will inevitably be a result of a passion and an interest and a deep immersion in that realm. But I also think that there is a kind of apprenticeship that is required, that you have to have a teacher, somebody that knows the subject matter as well as the series of issues that have been contentious around that subject matter and have brought forward the opportunities for critical thinking" In the context of the specific subject matter of educational psychology, the instructor wants his students to justify ideas, formulate arguments and defend their positions, and to "become fluent in the language of the discipline of educational psychology." Other topics the instructor believes that are important to include in a course on educational psychology are epistemology and philosophy of science; metacognitive self-regulation was covered, but "I touch on it briefly; I will probably expand my treatment of that." The course is presented as a "critical history of ideas," and the instructor's job is to "present some useful explanations of things." Students are expected to "understand the material … to get the gist of it ...They should be able to relate that information to other things that they know. They should be able to think critically about it, hopefully be able to situate it in a context." They should justify their ideas, formulate arguments, and take a position and analyze its components. "The … assignments, I think, target the kinds of things I'm looking for, with respect to being able to take a position and argue for it."

Metacognitive self-regulation was covered, but "I touch on it briefly; I will probably expand my treatment of that … The problem with self-regulated learning is that you can never get any sense of what the self is, and then when you do get an explanation it seems to me that all that you need to be a developed self, according to educational psychologists, is that you have to feel good about yourself (e.g., have strong self-esteem), have goals, and a strategy to achieve them … for me the whole idea of self-regulated learning is a very impoverished kind of view of human nature and personhood … the problem is that the text treats this as all wonderful news for educational psychologists and it's highly uncritical."

Difficulties include the students' lack of preparedness for learning higher order thinking, and their lack of basic language and argument skills (and the instructor holds the public school system accountable for their failure). "The problem is larger than this. Society does not value education sufficiently to direct significantly more funding toward ameliorating the problems." The large class size prohibits the kind of discussions that support students in exploring and elaborating their understandings, and the "formulaic" textbooks are not much help. "I am becoming increasingly concerned about students arriving at university being ill prepared to do university level work. However, there are many students that do very well and seem to me highly capable." Only favourable outcomes were mentioned: students "really getting" the material, some pursued grad work in the field, and others demonstrated a real interest in improving their thinking.

Interview A-2. Critical Pedagogy (~30 students, 1/2 semester)

This instructor is very enthusiastic about teaching thinking skills, and believes that they should be infused throughout the education curriculum. Critical and flexible pedagogy are extremely important to educators, and the failure to learn to think well has "dangerous consequences." The course concentrates on "critical and transformative pedagogy" and topics include thinking skills and epistemology. Emancipative and transformative learning are also key elements, as the focus is on "...empowering teachers to know that they are able to make a difference in the classroom by assisting students in becoming more critically aware, and also empowering teachers with the ability to know that they can encourage students to want to transform society in a positive way." The instructor is clear that student-centred methods work better than anything else: "... in order to help the students achieve a focus on higher-order thinking through the course...by giving the students a lot of freedom, direction, and basically starting right from the beginning and empowering them through their own ideas rather than saying 'This is how you're going to do it' and 'This is how I want you to do it,' but instead using a more facilitative approach."

While students can't be forced to learn to develop their thinking, many of them are keen to do so. Cognitive skill objectives were concentrated in the area of metacognitive self-regulation; beyond that, the instructor feels that it is important to understand "patterns of thought" that are prevalent in our society. "They need to spend some time in the literature that talks about the importance of being aware of how we think, the factors that influence our thought, what influences our thinking, and until they are really challenged, perhaps, in some of the ways that they have been thinking they're not really prepared to consider their own thought patterns."

A key element in the process is mutual trust (the construction of a safe place to share and to learn). The importance of discourse (both small and large group discussions) was emphasized; a wide range of topics was offered for student projects. One job of the instructor is to challenge students' thought patterns to stimulate new thinking. Only favourable results were mentioned, including raised awareness; student teachers reported feeling capable and empowered, and many of them seemed to have caught on to the value of higher order cognitive development. "It's kind of, it could be a vicious cycle, depending on what they're trying to further in the classroom, so self-awareness is a big component of the course that we offer here. If students don't realize themselves through self-reflection, where they are coming from themselves, what kind of thinking that they're engaged in, the value of higher-order thinking, the less inclined they are to be engaging their students with an awareness of those issues." Barriers to this process include lack of course time, students' preconceptions, lack of prior preparation, and lack of confidence. These problems sometimes led to an excess of "transmitting information" in the student papers (rather than reflections on their thinking, as the instructor intended for the assignment).

Interview A-3. Principles of Teaching. (~ 36 students, 2 semesters)

For this course, in addition to considering issues of curriculum and pedagogy, "teaching skills of inquiry" is the "primary focus," and the quality of questions that students ask is "huge" in importance. Problem posing is an important topic, as well as problem solving; an active and directed curiosity is encouraged. An example of a good question is "the student who goes in and observes, and wants to know why sometimes teachers answer questions but sometimes they throw them back to the students." In contrast, some students were more concerned to find out how long the students had for recess.

Metacognition and self-regulation are topics of instruction, and they are also educational objectives. A strong emphasis is placed on analyzing learning situations and learning strategies; one way that this is done is by presenting an educational task, and having the students work at it, before describing the theory behind the instructional technique. This was described as "having students look at different sorts of thinking, and different types of tasks that typically you would do with ...children ...before you then look at what's behind this, and why would we do this."

This instructor acknowledges a variety of outcomes: "There are students who, despite your best efforts, think that learning is about kids sitting still and receiving information and spitting it out again, and there are students who are really keen to get their kids thinking, and talking, and discussing, and looking at things from different perspectives, and research in the classroom, and inquiry." Sometimes the course work is applied, but sometimes it is not; there's always "the teflon-coated student where nothing sticks," and there are students "who, despite our focus on inquiry, or on thinking, teaching for understanding, giving out worksheets that are, you know, junk." The only other difficulty noted (if it could be considered a difficulty) was the variability in the level of students' preparedness for the work. "[S]omething that's remarkable to me is the variations ... with these young people that come into teaching, the variations in their ability to grasp, and then apply, what they have done in the course work." When asked for insights into the process, the instructor pointed out, "I've learned that students learn best by doing. I've applied that, and I will continue to do that as I look for student-teacher tasks, exercises or activities that help them make sense of why teachers do things the way they do in the classroom."

Interview A-4. Educational Psychology (~ 30-35 students, 1 semester)

This instructor does not deal with the idea of critical thinking, and regards this as a problematic notion ("too cognitive," without enough emphasis on social and emotional factors); however, metacognition and self-regulation are discussed under the topic "reflection on learning". Instead, higher cognitive development is seen as "social intelligence," a form of "interpersonal empathy" or "sensitivity" that is promoted through social interaction. "I want them to be able to listen to, and talk to, others about these matters so that they can learn from each other as well as from their own reflection and, perhaps, from any comments that I could make." This social intelligence allows us "to figure out whether folks are thinking, even though you have incomplete information about them." Development results from experience, especially of progressive discourses in a student-centred setting. "I have to turn much of that authority over to the students, and not make assumptions about what they need to learn." Objectives include reflection, along with analyzing and solving problems, and putting information in context; thinking hypothetically and envisioning possibilities are also seen as important educational goals. Reflective and explanatory writing are important learning processes. While the classic textbooks are considered too "encyclopaedic," alternative sources of ed psych material are available, and "people have really liked using what I'll call narrative and fictional elements for teaching ed psych, and I'd say the overall reaction has been very positive to that, and I want to see if I can do more with it … when you put it into a story for them then it coheres much better in their minds and it resonates more effectively. So they've responded quite well to that sort of thing."

A lot of group activities support the students in learning from each other. While being concerned with questions about the effectiveness of co-operative learning, the instructor nevertheless emphasizes group work on problem solving and assigns group projects, along with a variety of creative assignments. However, many were resistant to engaging in the work, had little prior knowledge or experience, and had little interest in higher order thinking when they came to the course. "…[C]lassroom management is a major issue, and assessment, …are all very high areas of interest for a large number of my students ... This being said, higher-order thinking, as I usually imagine the term, as it has emerged from the departments of psychology of the world, is not really something that they are curious about (as such)."

With regard to outcomes, many students worked well together, and "thrive on it." Sometimes a student would "take the ball and run with it, and come up with all kinds of interesting stuff"; on the other hand, there are "a number of students who are not sure that they want to be teachers, and are using the education program as a kind of a way to explore it to see if they really want to do it or not. Frequently they end up really not wanting to get too involved with the other people (this is my take on it, at least), and this has been a disappointment to me."

Interview A-5. Psychology of Learning Math (~40 students, 1 semester)

While this instructor acknowledges that teaching thinking skills is "very, very difficult," it is also deemed to be an essential pedagogical activity "because thinking skills are an important part of what should be integrated into every curriculum course." The instructor was inspired by research into teaching practices in Australia and California, having found that "there was a real focus on getting teachers to observe children carefully, to ask very, very critical questions, in terms of moving them along the continuum."

Thinking skills are taught in this course via a constructivist approach, through "open, but informed, dialogue" within a "community of learners," in a safe classroom environment. Metacognition, self-regulation and epistemology are discussed in a context of critical analysis and self-reflection. The objectives include challenging the students, in order for them to develop new perspectives (changing worldviews) and deep understandings of learning strategies, and to support them in understanding how learners think about the problems they face. "What I really want my teacher candidates to do, is to take what they have learned from those readings, and talk about what the implications are for themselves as educators in the classroom … It's very important for me to not take anything at its face value but to critique it in an informed way." Practical skills are paramount, but understanding the uses of various practical methods is crucial, as "I wanted to make sure that when I designed a course, I was delving into the whys behind the practical things that my students were doing in class."

While some students didn't manage to attain the levels of reasoning that the instructor sought on their assignments, in general they "rose to the challenge," despite their lack of prior preparation, lack of time in this one-term course, and the fact that they have been fed "a lot of misconception" in their educational history. A lot of attention was paid to metacognitive aids (prompts, organizers, and think-aloud protocols), since "some of my own students seemed to lack some of those metacognitive strategies, some of those process strategies, some of the organizational strategies."

There is evidence of success "… in the reflections that they do, that they write for me, I see evidence of their ability to carefully synthesize information, so take three or four papers and really talk about the similarities and differences among those papers in very broad brush strokes to come up with a major theme." The instructor was gratified that "many of the students that were in that course, immediately on completion of their Bachelor's degree, went on to take their special education qualifications, because I think that they realized that there is a great deal to be learned about the ways in which teachers ask questions and structure activities in the classroom to maximize learning."

Interview A-6. Educational Psychology (~ 90 students, 1 semester)

This instructor feels that the most important thinking skills for teachers include the abilities to analyze situations, including their students' thinking ("get into the metacognitive space of the learner"), and to understand one's own strengths and weaknesses in given situations. "So you have to look beyond the students' providing the right answer, to try to get some understanding of how the student is understanding what's going on. So it's a fairly constructivist approach."

Thinking skills are not explicitly detailed, as "I approached it under the guise of problem solving and implications of problem solving." The course is student-centred, case-centred, and theory-centred; students often need to be "pushed" to participate, and "tricked" into thinking about the qualities of their thinking ("They're not intrinsically interested in it, they don't see it as something that they need to understand, that they want to know about").

A number of difficulties were mentioned, including the instructor's assessment that this class had a passive-aggressive nature, and sometimes refused to respond to a question during a lecture session, or complained bitterly when asked to work in groups. "Prying feedback out of first-year students is actually one of the biggest problems, " and "the single most important thing, and the most difficult thing, is to get the students to engage… the most difficult thing is getting them involved in being able to see things from the point of view of being a teacher, to analyze things from the point of view of being a teacher." They were not only resistant, but also unprepared for the work, preferring instead to be told what they should know ("the sponge mentality"). "Their idea of a perfect course would be 155 handouts that you could give them so that in any given situation they could pull out the right handout and apply it." However, this changes after the students have had some practical teaching experience, and "they come back from that and their attitude is completely different. They see that it's not really a set of tips and tricks. They see that there's something going on, they're looking for the little wheels turning inside the students' minds." The only other favourable outcome mentioned was that sometimes some of the students managed to engage themselves in class discussions.

Interview A-7. Educational Psychology (~50 students, 2 semesters)

This instructor promotes the value of developing higher order thinking and metacognitive skills through discourse, and believes that instructors should work together collegially to develop their own practices. Course objectives include gaining a deep comprehension that allows the synthesis of course materials; students are strongly encouraged to be concerned with applying their thinking to real-life situations. Bloom's taxonomy of thinking skills is of particular interest; and assessment is aimed at evaluating students' thinking: "I have to be very careful that my exam questions, even multiple-choice questions, cover all of the different thinking skills." Research papers also provide an indication of the students' analytical and evaluative thinking, as "I think, when they are writing a research paper, they have to have all of the critical thinking skills." Student engagement, especially the qualities of the questions that they ask, is an essential factor, and "When a student is sitting there in class, and very quiet, that always worries me. If a student is asking a question that links back to their personal life, I think that they are making a connection between a piece of knowledge and how relevant that is to themselves."

The students are instructed to keep educational objectives in mind as teaching progresses. "As a teacher you always need to be goal-directed, as a learner you need to be goal-directed … I've always felt that an effective teaching should always have the outcome in mind."

Metacognitive self-regulation (self-awareness, self-reflection and self-regulation) is an important course objective; understanding students' thinking is another important goal. "We talk about the idea of being able to think about what you're thinking, which is different from just thinking."

Group discussions allow for practice in sharing ideas and in summarizing different points of view. Positive results included students sharing about their interest in the subject, and looking for opportunities to learn more. A study guide is available for the course but many students don't bother with it; they are in "survival mode," unconcerned with higher-order thinking, unprepared for the process, resistant to the tasks, and are already convinced of their competency, (despite their apparent to the instructor) lack of skills. "In terms of their actual critical thinking in the course, I'm not sure that the majority of my students are able to actually understand it and appreciate it and actually reflect on it. I hope that they have the basic foundation of the course and, with experience in learning, that they become more reflective."

Interview A-8. Philosophy of Education (~55 students, 1 semester)

This instructor adopts a feminist approach and a post-structural perspective, and claims that it is the instructor's job to interest the students in the work of educational philosophy (despite the fact that they are generally poorly prepared for this work, and their competencies are quite varied). Critical thinking is not a topic in itself, but "thinking critically" is nevertheless a top priority. "The way I look at, or I define, higher-order thinking is: how critically can you think? How do they not only challenge what is given out to them, but also to be able to challenge some of the things that students have believed in for a long period of time. So to me that is higher-order thinking, instead of anything else."

The course is designed to support students in challenging habitual thought patterns and beliefs ("thinking out of the box"), and in developing their own philosophies. "The way I structure my courses is to provoke them into thinking and questioning." Thus, critical thinking and inquiry were course objectives, along with understanding learning strategies in order to apply the course materials effectively.

While the students want to accept the instructors' authority and have information transmitted to them in a well-structured environment, this course focused instead on group discussions, and on stimulating them to think in new directions. "I found that a very good way of trying to promote critical thinking is to, based on a philosophy, write a screenplay, or a story. And then the use of videos, not only documentaries which are available, but also the use of commercial feature films or commercial cinema. I think that helped a lot in encouraging them to question."

Topics include the work of Eastern philosophers, along with transformative learning and the development of critical dispositions. Epistemology was not a topic of the course, but "it comes in, how knowledge is formed, what is the basis of knowledge, and so on, but more so in the discussions, within the parameters of the topic that is being discussed, in relation to a particular philosopher or a philosophical school of thought." The instructor would "provoke them into thinking and questioning" by challenging their historical understandings. Methods included creative and reflective writing, combined with creative student projects. Students wrote ("informal") weekly reflection journals in response to the assigned readings, and this process allowed "the critical abilities [to] come out very nicely." Outcomes were various; some students did not engage well with the process, while others managed to challenge authoritative belief systems, formulate good arguments, and create innovative projects. Some students were very concerned with the lack of structure that the course provided, and wanted more direction, while others enthusiastically challenged historical authorities. "I wouldn't say that by the end of the term, which is thirteen weeks, that all of them got it, but I was pleased to see that the response was very encouraging." Many student evaluations of the course were highly positive, and the instructor noted that "the seeds of transformation were already there."

Interview A-9. Development and Exceptionality (~35 students, 1 semester) This instructor is also very enthusiastic about teaching for higher order thinking, and applied the method of problem based learning, declaring, "not only does it work, it works beautifully, and it fits my teaching style beautifully … there's this whole theoretical notion behind it, and all of the support literature, that what I was doing was not only right, but very effective."

The students in this course were clearly interested in higher order thinking, and were provided with plenty of opportunities to develop their cognitive skills in authentic problem situations. "I set it up in such a way that it's as close to the classroom situation as possible. The problem is embedded within the muddle of the classroom, so the disposition is almost forced on them." Objectives include analysis and synthesis, asking good questions, and a lot of problem analysis, which involves not only thinking critically, but also questioning one's own beliefs and perspectives. These functions were enacted in co-operative groups, and included many authentic situations where the students played the roles of teachers, and the instructor would play devil's advocate, throwing "curve balls" and issuing memos from the school administration (or counselling office), which challenged the students to consider what they must do as teachers.

Discussions include considerations of the "problem space," as well as epistemology and every aspect of metacognitive self-regulation (including personal responsibility for one's thinking and learning). "I do want them to understand that they can approach things in a variety of ways. I also make them go through and question their own beliefs, because one of the things they have to do is to identify personal biases, in order to clear that out of the way for the other thinking that they've got to do". Also, "I do spend a fair amount of time talking about metacognition … I think that it's an important thing for them to understand, how they can regulate their own thinking ... You know that whole thing about being a reflective teacher, a reflective practitioner … I think that that's very, very true. I think that you have to be like that in order to continue to improve. It doesn't mean that you're always going to make the right decisions, but it only becomes a mistake when you keep doing the selfsame thing."

Although some students resisted the process (presuming that they were already adequately competent, simply seeking information and correct answers), and others had difficulty with the methods use, there were many favourable results (where students managed to break through to new levels of understanding).

Interview A-10. Philosophy of Education (~70 students, 1 semester)

This instructor is clear that educational philosophy is an important subject for educators, and is gratified when students also find the subject to be of value to them. While critical thinking is presented as a topic, the idea is accompanied by the critique that "talking in terms of 'the thinking skills' is a bad thing to do. I think that the model of skills is inappropriate for the mind." On the other hand, "Having said that, so that you understand what I mean about the word 'skill,' I would say concentration, commitment (that comes high), but basically I think the most important thing is to grasp various disciplines or bodies of understanding." The main cognitive objective are coherence, precision, clarity and consistency; these allow for understanding the material and becoming fluent in the discipline; personal responsibility is another educational objective, but creative thinking is not a goal for this course; rather, "I'm looking for understanding of bodies of material. Having said that, I should say that I am looking for a critical spirit, and I am looking for people who question things." Provoking and challenging questions are used to stimulate the students to take positions and defend them.

Critical dispositions are termed "character traits" that are conducive to learning, but the difficulty is, "I don't think you can teach open-mindedness. I think you can encourage it … and thereby I think that people acquire it. Like a virtue theory, you help people to become involved, you practice the virtues and thereby you acquire them."

Epistemology and philosophy of mind are among the subjects discussed in the two-hour lectures with about 70 students, and smaller tutorials provide opportunities for students to practice arguing with Teaching Assistants (and each other). "I am trying to build a positive view; I try to focus each class on something to grab their attention, because most of the course is fairly abstract, because it is a philosophical course, but I try to tie it to some local story, or something from the press, or something from teaching, to give it at least an appearance of something that's of relevance to someone." The instructor shared that the course design is evolving toward a more student-centred approach: "I think that I'm going to have to work harder on structuring it, and giving the students feedback in terms of what they want to know rather than what I think they should be knowing."

The instructor acknowledges the variability of observed outcomes; while some students are enrolled in the subject and actually acknowledged their enthusiasm, others failed to see the point, and did not engage in much philosophy. Some students take the course to fulfil their program requirements, without actually having much interest in the subject, and who "don't really want to be there." In claiming that student preparedness is "enormously varied," the instructor acknowledges, "What I'm implicitly doing there is criticizing the high school curriculum; it doesn't prepare people for this kind of thinking quite enough." On the positive side, some students (who had had no idea of the importance of philosophy when they enrolled in the course) acknowledged afterward that they had discovered a great deal of value in the subject.

Interview A-11. Senior Secondary Education (~35 students, 1 semester)

The instructor found that some of the (post-degree) students coming into this course were interested in higher order cognition, but the variability in their basic skills, and in their levels of interest in the subject, ran counter to the process of developing their analytical and problem-solving skills. With regard to thinking skills, reflection and problem solving skills are considered to be of primary interest.

Transformative learning and transformative practice are included among the course topics, and this idea was described as "Basically, new concepts, new ideas or new trends or practices that are occurring in that direction, how that could help them at teaching in a different way a little bit." Other goals included synthesis of the course materials, and a variety of methods were applied. Reflective and philosophical writing assignments were assigned to support the process; sharing their experiences student teaching is also important to the development of new perspectives. Role-playing, films, table talks and group projects were also used, and the instructor pointed out the importance of using "current" pedagogical resources, as, "It's important to remain current in the new trends, in the new issues that may be on the scene." "We want them to relate [their reading] to concrete work or practical situations. Also, you're looking for their own personal input, personal views (with the support of readings from the literature) – primarily we're looking for how they would resolve, or deal with, particular issues (and their understanding of it). "Higher-level thinking tasks" were involved as the issues and problems were addressed, and the instructor continuously assessed the students' thinking skills (and designed the final exam for that purpose). The instructor has also visited the schools to observe the students as they taught.

When asked about remarkable or disappointing outcomes, the instructor acknowledged, "Their writing skills seem to be problematic." With regard to student preparedness for higher order cognitive work, "I guess they should have some intellectual goals, or intellectual standards that they want to reach … there were a few that have shown that particular dimension. Others are there primarily just to get degrees, or to get the work done, and try to move on. You do get calls after they move on, information that they're looking for once they're in the workplace, or in the teaching environment, realizing that some of the information that had been discussed or addressed is, finally, very important."

Interview A-12. Senior History Education. (2 sections, ~ 35 students each, 2 semesters)

This course is given to education students in a second degree program, and it is very strongly oriented towards higher order cognitive development and thinking skills. "We do a lot of reflection. A lot of them are fed up with reflecting ... because we really want them to think about how they think. We want them to think about the strategies that we are introducing them to. We want them to think about particular issues that are happening." The instructor bemoans the fact that many faculty members fail to implement similar approaches, because these skills are extremely important for the fulfilment of the ultimate purpose of education: social action

Among the plethora of objectives which were named, "taking action to bring about a better world" is foremost; self-transformation is a related goal, as are the requirements to think for oneself and take responsibility for learning: "You have to learn how to learn on your own. How to look for information, how to look for resources; how to take down important information from a universe of other information that you may come across." Thinking in action (formulating arguments, challenging beliefs and thought patterns and creative thinking are all involved in successful learn in this course. "I always emphasize critical thinking as well as creative thinking in my classes, because we have this reputation of working hard to develop critical thinking, but not hard enough teaching how to think creatively." Aside from concentrating on analyzing educational situations and strategies, students are required to engage in a social consciousness project in their communities, which (they reported) "really changed them." As the instructor reported, "We develop particular habits of mind to enable them to be able to compare and contrast things, to provide evidence for claims that they make, to back arguments with supporting evidence, and having open-mindedness ... being open to change one's mind in light of evidence." Thinking (and writing) through different perspectives is thus strongly encouraged; issue-based analysis of scholarly articles is an important part of the process. "That knowledge is something that we can create. It's a construction; knowledge is something that we all should have to contribute to its creation. That we should be constantly challenging and questioning the information that we come across, and not just taking them at face value ... every year I have tried to include more and more activities that will lend themselves to critical thinking."

However, while some students were interested and engaged in the process, many were unprepared, resistant, and "very grade conscious." Some poor outcomes were noted: "When I go out to observe them in classrooms, I do not see a lot of critical thinking going on. What I see going on a lot of the time is overhead after overhead after overhead. You sit there at the back of the class, where you are observing them, and you think, "What happened to all the different ways of teaching history (or social studies) that we discussed? What happened?" I see a lot of note-giving."

Interview A-13. Teaching Secondary Science. (~30 students, 1 semester)

This course is about understanding philosophies of science from different perspectives, since the notion of multiple approaches to the subject is acknowledged by the instructor to be a fruitful one. Thinking skills, critical dispositions and metacognitive regulation all have their place in the syllabus, in addition, "We talk to them about transformative learning ... [but] setting up a classroom so that students can have a transformative experience is not a trivial thing, and I'm not even sure it's possible in preservice teaching, or preservice education.

"I'm quite big on critical literacies, so the ability, for example, to decode, interpret, popular science materials. To ask questions concerning the authors of those science materials, the nature of the understanding of the nature of science itself that are embedded within those kinds of materials. Analytical skills, of course, are quite important in science; logical thinking skills. We try to emphasize as much as we can in the way of critical thinking skills in science." Deep thinking about science ("where theories come from, how theories are built up, how observations are made, the role of theory in observation, those kinds of thing") is the main focus of the work.

The importance of higher order thinking is recognized, but the course design is not built with this particular topic in mind. This is an after degree program, so the students have had some experience with higher order cognitive skills, but "very few" are actually well prepared for this process when they enter the course, as, "they've often not done a lot of critical thinking about the nature of the content itself, the science process. They see science as a very linear process, as a science heuristic, the scientific method, and this kind of thing. That is a very tenacious belief ... If I had the power to redesign science teacher education programs, I would make it mandatory that people going on to be science teachers take one or several course in the philosophy of science in their university teacher preparation."

Concept mapping is used as an instructional method, and students are encouraged to reflect on their use of ideas. Objectives include logical, analytical and metacognitive skills, which should lead to deep comprehension, synthesis of materials, and the development of various approaches to learning theory. However, a great number of difficulties were noted; very few students were prepared to engage, many of the faculty do not support this kind of work, and the students are caught in a "nightmare" where they are suddenly called upon to direct themselves in their educational development. In particular, they are hampered by their "naïve realist understanding" of pedagogical constructs; their lack of epistemic sophistication impedes the development of higher order cognitive functionality. "I think this is something that universities as a whole will have to come to grips with, insofar as a lot of the challenges that we're facing (particularly in areas of sustainable development and the environment) require higher orders of critical thinking that transcend any one discipline. We have to start preparing professionals that have a capacity to think critically across disciplines."

Interview A-14. Educational Philosophy (~ 100 students, 1 semester)

Critical thinking is not a specific topic of study in this course, but critical analysis is nevertheless an essential focus. "I think that critical thinking skills arise out of the ability to read critically ... I think that the connection between reading and thinking is at the heart of what we're trying to do, is to develop their critical thinking skills with the range of readings that we have them do." As for critical dispositions, the capacity to be open-minded is important, and also,"they need to be patient, not only with what they're reading, but with themselves, with the difficulties that they're having with various readings. Sometimes people expect to get the idea immediately, and sometimes it just doesn't happen, and then some people get discouraged." Metacognitive self-regulation was not specifically addressed, but simple strategies to aid learning (such making notes in the margins of the text) were pointed out during class sessions.

"The ability to follow an idea through logically" is cited as the most important thinking skill to be developed. "Things are not always black and white, and it's hard to maintain a position uniformly sometimes for them, because you realize that issues are complex. Particularly since what we're talking about (in large measure) in philosophy of education are issues of value, dealing with values, and these are complex … frequently, there's no one correct answer, so that's a challenge for them." Writing clearly is an essential objective, as "Their writing skills are pretty varied; some are eloquent, others are semi-literate."

Since discourse is the primary teaching and learning method, the importance of student engagement is recognized. "It's a challenge to promote reflective discussions with a group of a hundred students, so I put a fair amount of time and energy into figuring out how to work the class into small group discussions so that they can individually raise questions, talk them out amongst themselves, and then reconvene as a larger group and bring their questions to the larger group as a whole."

The instructor is looking at how to improve the course by fitting more audiovisual materials (such as film clips) into the term, since the students seemed to be quite interested in such items. A remarkable result was the students' production of original and creative fiction, which served to illustrate philosophical principles; some of them wrote "with considerable thought." Some students also did a nice job of developing their own philosophies of education. On the other hand, "There are those of course, whose commentary is clichéd, or just not particularly thoughtful." Some students "come in at the beginning of the term having already decided that they don't like philosophy of education, and do their level best to skip as many classes as possible and don't do the work if they can help it." In general, "most of them are pretty open-minded; and some of them see a real need for having a philosophic grounding for their educational practice. Others simply don't see it."

Appendix B. Case Study: Initial Interviews with Education Instructors

Please describe briefly your academic background and experience.

Please explain your perspectives on higher-order thinking, higher-order cognitive development, and the teaching and learning of thinking skills and dispositions.

Which educational methods, practices and assignments do you see as suited for supporting and facilitating higher-order thinking?

What is the relevance of the following subjects to the pedagogy and the practices of learning and teaching higher-order thinking:

Critical thinking
Critical dispositions
Metacognitive self-regulation
Theories of knowledge and knowing
Dynamic and transformative learning

What is your perspective on your students' preparedness, or their interest, in learning and teaching with regard to thinking skills and higher-order cognition?

Is there anything else that you'd like to communicate about your experiences of teaching and learning with regard to higher-order cognition?

Appendix C. Case Study: Interviews with Education Students

Please describe your academic background and your current program.

What are your career aspirations?

What thinking skills, and what attitudes or dispositions, do you consider to be of greatest importance in education?

What does 'higher-order thinking' mean to you, and how do you recognize it?

What are the most effective ways to teach and learn higher-order cognitive skills?

What are the most important or interesting things that you have learned about higher-order thinking, learning about complex subjects, or solving difficult problems?

What is the relevance of the following subjects to the pedagogy and the practices of learning and teaching higher-order thinking:

Critical thinking
Critical dispositions
Metacognitive self-regulation
Theories of knowledge and knowing
Dynamic and transformative learning

Please describe the process of developing the work products that you generated for this class.

Is there anything else that you'd like to communicate about your experiences of teaching and learning with regard to higher-order cognition?

Appendix D. Case Study: Second Interview Protocol for Professors of Education

1. What thinking skills do you consider to be of greatest importance in education?

2. What signs of higher-order thinking do you consider to be important?

3. Describe the most important considerations with regard to teaching and learning critical and higher-order thinking that affected your design of your courses this year.

4. What were the most remarkable results that you observed this year?

5. What were your biggest disappointments?

6. What did you learn with regard to teaching and learning about thinking, and how might what you learned affect your design or delivery of future courses?

7. I'd like to discuss with you how you approached the following topics:

a) Critical thinking skills and dispositions
b) Epistemology
c) Metacognitive self-regulation and self-regulated learning
d) Transformative, emancipative and dynamic theories of learning

Appendix E. Case Study: Questions for Students Regarding Online Discussion

How much use did you make of the online discussion forum?

Was this participation valuable in terms of developing your thinking?

Were you aware of the participation grade assigned to this task?

Were you satisfied with the tool's usefulness?

Were you happy with the use you made of it?

Did other people use it well?

Did the moderator do a good job?

Appendix F. Survey of Education Students

Please signify your level of agreement with the following statements by selecting a response from 1 to 7.

Critical thinking was an important topic in this course.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

I spent a lot of time learning about critical thinking in this course.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

Epistemology (philosophy of knowing) was an important topic in this course.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

I spent a lot of time learning about epistemology in this course.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

Metacognitive self-regulation was an important topic in this course.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

I spent a lot of time learning about metacognitive self-regulation in this course.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

Self-regulated learning was an important topic in this course.

1	2	3	4	5	6	7
Strongly Disagree						**Strongly Agree**

I spent a lot of time learning about self-regulated learning in this course.

1	2	3	4	5	6	7
Strongly Disagree						**Strongly Agree**

Critical spirit (the disposition to think critically) was an important topic in this course.

1	2	3	4	5	6	7
Strongly Disagree						**Strongly Agree**

I spent a lot of time learning about critical spirit in this course.

1	2	3	4	5	6	7
Strongly Disagree						**Strongly Agree**

Transformative and dynamic learning was an important topic in this course.

1	2	3	4	5	6	7
Strongly Disagree						**Strongly Agree**

I spent a lot of time learning about transformative and dynamic learning in this course.

1	2	3	4	5	6	7
Strongly Disagree						**Strongly Agree**

1. Please name a) your program of study, and b) your main research interest (if any).
2. What does 'higher-order thinking' mean to you, and how do you recognize it?
3. What thinking skills do you consider to be of greatest importance in education?
4. What attitudes or dispositions do you consider to be of greatest importance in education?
5. What are the most effective ways to teach and learn higher-order cognitive skills?
6. What are the most important or interesting things that you found out about higher-order thinking, learning about complex subjects, or solving difficult problems?

Appendix G. Study 2: Summaries of Interviews

Interview G-1. Initial Interview, Instructor 1, Courses 1 and 2 (Philosophy of Education)

Instructor 1, who taught two one-semester courses in philosophy of education, was educated in international education (including peace education), multiculturalism in education, and gender and education. This participant has taught university courses for about 17 years. Higher-order thinking is considered to be "thinking that can bring about a change … to the way that [students] think about the world, about their community, about their fellow beings and about themselves …with the hope that it will one day reach a critical mass of people who think outside the box, and think in terms of a change … I don't think that there is a hierarchy of thinking." Students have different needs, and the teacher must be able to identify what those needs are. Everyone has something to contribute to the class, so "you push them a little, you nudge them a little, you probe a little, to get those questions out, and sooner or later they realize that they know these things, they have the ability to raise these questions. It's like challenging them a little to search inside and bring these things out ... It's basically just to guide them through various means to look for that thing … This has to be worked upon in a team, where the professor and the student do the work together to bring those things out, to see what, exactly, the questions are … the real questions are that could be answered."

The importance of creating a safe communication space was emphasized. "Unless the group has the confidence of faith that it can actually communicate without any fear in this learning space, all these things that we've been talking about (challenging the authority of the text, of the teacher, of other things) that cannot take place … So to make that learning space a safe space, my intent is to make them aware of the responsibilities of freedom of expression too."

In the first two weeks of class, "I felt that in the first two weeks there was an amazing array of voices which I heard in the class. They were dissenting, they were challenging authority, they came out with their own experiences … So that's what my experience of this class has been, what my experience has been with most of the classes." Students in prior years (and even in the first two weeks of this course) have reported that their perspectives were changed … in terms of increased reflection, and better understanding, of the sources of their attitudes and ideas. The instructor, however, did not expect much transformation to occur very quickly. "Perhaps at the end of the course, or a couple of months after the end of the course, perhaps I'd be able to say something about that."

Interview G-2. Student A, Course 1

This student in the childhood education program believes that the "ability to think critically" is of great importance in educational settings, and that knowledge (which we each create for ourselves) is far from absolute: "I think that everything is really conditional, and situated, and based on where it's happening and why it's happening and with whom it's happening." Asked about thinking skills, this student recalled the latest descriptions from the updated Bloom's taxonomy: "to know, understand, apply, analyze, evaluate create," and also recalled another important lesson on human action from a different course: "After that you want to decide what to do with that information. Now that you've created an opinion about it, what are you going to do?"

In order to teach higher order thinking, "I think a lot of conversation and dialogue would be required … a lot of responsive writing, a lot of critiquing … conflict, a little conflict between opinions is important, because then you're challenging your own thought – to really defend why you think the way you do." Also, "In that class we learned more what the problems are rather than how to solve them. So I feel that we needed to create our own opinion, and apply all of that information ourselves, go through the process of higher order thinking ourselves, but I don't think it was ever explicitly taught in the class." The understandings which we create should not be viewed as isolated from variant ideas, as "it's not just believing something, it's knowing why you believe it, or is there something else that you could believe, or what are different things that other people believe that they might have reason to believe for themselves." Thus we should take pains that the information which we create is carefully examined, and well circumscribed, as, "More fair information, less biased information, more information that recognizes its own limits, like I like when I read in texts at the very end when the authors talk about what their limitations were and what they can do to continue their research."

When asked about the course content with regard to higher order thinking, Student A said that none of the topics under review (critical thinking and dispositions, epistemology, metacognition and self-regulation, transformative and dynamic learning) had been covered in the course.

Interview G-3. Student B, Course 1

This student (also in the childhood education program) described higher order thinking as "thinking beyond the obvious … being able to generate new ideas independently, and then being able to share them, express them." Critical thinking was seen as the ability to reflect; it was connected with lifelong learning and an intrinsic motivation to learn. When asked about critical dispositions, Student B replied, "you want people to be open … I think a little bit of creativity gets in there too," and also mentioned persistence as an important attitude for learners to cultivate. Another personality trait was also described as relevant and important, as, "There are some people who are resilient, and it doesn't matter what level, necessarily, of intelligence they have or what chances they're given, the fact that they're resilient helps them to be successful in the face of any other problems they have."

In order to teach higher order thinking, "I think you have to know your students, meaning you have to have an idea of what interests them, how they learn … You have to give your students a certain level of independence, and they have to have confidence in you, that you will let them go along a path ... So you have to be a guide, you're not pouring knowledge into them. And you have to give them lots of variety of experiences, not just sitting at a desk and looking at a chalkboard … real world experiences."

When asked about learning processes, social interaction was described as an important factor. "I don't realize I have an opinion until I start talking to someone about it, and then I realize that I have learned something."

When asked about course content with regard to higher order thinking, Student B agreed quite strongly with the idea that critical dispositions was an important course topic, while none of the other subjects under investigation in this project was covered. At the end of the interview, Student B suggested, "Teachers in teaching education programs need to have more opportunity … we need to practice higher order thinking. We need more training (if it's possible) in creating an environment for students that develops higher order thinking."

Interview G-4. Student C, Course 1

For this student of English language education, the most important thinking skills were described as, "Making links to different course input, things that you're learning in different courses. Looking beyond the surface and seeing the foundation of how things work, rather than the surface representation."

Student C agreed that critical thinking and critical dispositions were important course topics. When asked about the results of learning about these topics, the reply was, "Learning the reasoning behind a lot of the things that are happening. And the mentality of different people, and governments, and the reasons why things are the way they are. So you want to look deeper into good reasons why things are going on." As for critical dispositions, "You want to make your own learning. You want to be motivated to learn. You're learning for yourself in order to improve your own attitudes." Teaching and learning higher order thinking was about, "Taking something that you're learning and linking it to your experience, and making it your own, making it your own knowledge, and coming up with your own theories of why things might be the way that they are ... You want to foster in your students the motivation to make your own learning and make your own knowledge, and go out and seek knowledge, rather than just handing it out to the students."

Allowing for individual differences in learners is seen as important. "The way things are presented to you might be in a different register, and it might just be very beyond your style of learning." Learning unfamiliar material might mean that you need to, "Read it over and over, and try to find different things from it." Student C also shared, "I'd like to be more critical of myself and my own thinking, and see where it leads me. The way I think, and the way I approach things, because maybe it can help me in some aspects. My studies, or the way I deal with people …"

Interview G-5. Student D, Course 1

Student D is an independent student, and a math teacher with several years' experience, who suggested, "A good thinker is a critical thinker, an analytic thinker … I'm a mathematician by training, so it just comes naturally. I like analyzing things before I form my own conclusion." In addition, thinking skills include, "Evaluating things when you think about something. Evaluate the situation … where does it come from? If it's a problem, what was the source? And, before you even think of a solution, does the solution even exist? … A critical thinker tends to weigh things over before he forms his final stand or position."

This student pointed out that most people would see a conversation about thinking as obscure, and that the "average person" (even the "average" education student!) is hardly concerned with what characterizes good thinking, or good thinking skills. While Student D couldn't immediately identify any critical dispositions or attitudes, prompting brought forth the declaration that flexibility and open-mindedness are, "Very, very important … You can never arrive at any conclusion without being open-minded to all the possibilities. You have to be open-minded about anything. Even if you feel that you're 100 percent right."

When queried about course topics related to higher order thinking, the response was, "It wasn't about thinking; the course wasn't about thinking." However, when prompted to share about insights into thinking gained from participating, the reply was, "I discovered a lot about myself that I didn't think was possible … [I]t was not the kind of reading material that I'm used to ... I thought that the readings were out of my league; it was not the kind of stuff that I would read normally. [It was] difficult at first, yes, but then you read, and read and read and read, and you develop an appreciation of how the writer has put time and effort into producing this." To write an essay for the class, "I had to be organized. I had to set goals. I had to be a bit methodical, which is what I learned in the first place in my field, in mathematics … I guess being methodical helped; being organized helped a lot."

The course "gave me a lot of perspectives on things. For example, I would be doing my journal, and, OK, here's my perspective, here's what I know. Then you come to class, and you realize: oops, there are other views on the same topic; it's not only this thing (which I know), but there are other things that other people know and I don't know … [S]ometimes I'd form an opinion about something, and then in class I'd think, what was my position before? And now why do I see it changing? … [Y]ou draw upon your own experiences on a particular topic, and you realize it's so much different (because you come from a different culture), and noone seems to agree, and then you learn about other people's experience of the same thing, and you realize the diversity of people, and you're just one particular player in that diverse universe."

Interview G-6. Student E, Course 2

Student E wants to teach pre-school children in day care. To this respondent, higher order thinking means, "Thinking outside the box. Not just taking what you've been told is the right way. Thinking critically is looking at all the different pros and cons and other ideas … it's not just one train of thought … it's been thought of from all possible angles, and the strengths and the weaknesses have all been thought of … Analyze it." When asked about dispositions, this student replied, "Some people are closed-minded; being open-minded it allows you to think more critically. Optimism. Self-confidence."

The educational philosophy course did not concentrate on thinking skills. "The class didn't really teach us how to think critically … I was in another class this semester [about educational policies] that was really all about critical thinking …we learned about critical thinking, what it is … Social reform, because we were thinking about, 'is this fair, is this just, is this right?' Equality, peace, love, that was the main issue … in that class, we learned [that] there is some sort of injustice, in everything. Even if it doesn't seem like that, there's always a hierarchy in everything, and somebody is always being shoved to the bottom; somebody's not having a fair chance, or something's going on that's unjust."

Reading, watching videos, and discussion were seen as effective ways to teach and learn higher order thinking skills. Class discussions, where people reviewed different sides of an argument, are especially helpful from Student E's perspective. Dispositions were also seen as important: "I have a critically thinking mind; I always think critically about almost everything. Even if I see a commercial on TV, I think, 'What are they trying to do here?' That's the kind of person I am ... I have that train of thought in me, the disposition to be critical .... [P]eople that don't have it just kind of accept whatever it is, and they don't even know what the other side is. They just pick their own opinion on it, and then that's it. And nothing else really matters. And that's the reality to them ... The way that you accept what is true knowledge, what knowledge is to you, it's either going to be critical or it's not." (When I asked if this participant had ever considered this issue previously, the reply was, "No. I never really thought about it.")

Collaborative and social learning is "Very relevant. How could we have a discussion in class, or any kind of debate, any kind of critical argument if there was no social environment, if we weren't collaborating?"

Finally, this opinion was shared: "This class that we met in was not a good class for this. He didn't really go into it, critical thinking, that much ... If I hadn't been taking the other course at the same time, I don't think I would have known how, so well, to think critically based on the one class, because he didn't really tell us how to do it."

Interview G-7. Student F, Course 2

Student F is studying childhood education to become an elementary school teacher. Higher order thinking is, "Metacognitive, thinking about your thinking. Critical thinking is more, not just taking ideas without questioning them, it's about questioning ideas." Metacognitive self-regulation was seen as, "Regulating your own thinking about your thinking ...Self-talk would be a major component. Let's say you're stressed out about an exam, and you're thinking, "I'm never going to do well, I'm never going to cover all the material," and you're anxious about that, you can just tell yourself, "It's going to be OK, I'm just going to do the best I can, and I'm just going to cover this first, and I'm going to go onto this, and I'm not going to worry about it, I'm just going to do it calmly and try my best."

The idea of cognitive development was also related to self-regulation and self-regulated leaning. "The nature of this course, of courses in education and psychology, you basically have to regulate your own learning to be successful in the class, because it's not really a very structured class. I guess self-regulated learning is necessary in order to think about the material at a higher level, and to really think about your own thinking and analyze that."

When asked about dispositions, the reply was, "The professor in the class addressed the fact that it was important to think critically about these works, to really think about what you agree with and what you don't agree with, and to come up with your own hypotheses ... You need to be opinionated, to have your own opinions, in order to agree or disagree with other people's ideas? ... I guess you have to analyze things as well ...Criticize. Evaluate."

Student F felt that critical thinking, critical dispositions, epistemology, metacognition and self-regulated learning were all topics in Course 2. Effective ways to teach and learn higher-order thinking skills were addressed, as, "You could teach about effective strategies for learning. You could have them read certain passages from philosophy and have them critique it. Trying to get students to be aware of their own thinking. ...You could also present controversial ideas to a student, to see how they react

… You could also try presenting false information and see if they catch on to it or just eat it up."

Collaboration is relevant. "It's important to be able to share ideas with others, and almost debate your ideas, and try to get to the root of the other person's thinking (or your own thinking), and try to see if there are certain ideas you feel need to be revised."

The most important things about higher learning include working to understand an author's ideas. "I had to take philosophy, and dissect it (in a sense), and really understand what it means, because sometimes it's not as straightforward as you think, sometimes you read it once, and you have to go over it a few times in the context of that philosophy, to understand what it means. Another way would be to not just blindly accept other person's ideas, but to really analyze them and think about them …It's something that may be challenging to teach, because you can really teach about the theoretical aspects of it, what it involves, how to do it, why it's important; but then again you can't really enforce that your students are going to do it just by teaching about these things. So you really have to give them opportunities to do so. And evaluate them as well, on how you think they did that in context."

Interview G-8. Teaching Assistant 1, Courses 1 and 2

The teaching assistant for these educational philosophy courses has a degree in interdisciplinary contemporary philosophy. Higher order thinking was described as, "Being able to conceptualize a topic, or subject, from different angles, and being able to have varying perceptions on the same issue, and critical thinking does play a role in that ... Being dubious … having an attitude that is not completely willing to accept what you've been told all the time …Curiosity is important as well …[I]t's not just an entity, a skill that you can pick up … If I were to walk into a laboratory right now, I would not be a critical thinker because I don't have all of the knowledge to be able to assess the different perspectives and which one I think is most valid … Communication skills. Being able to communicate, and also being able to receive the communication from other people. I guess it's the absence of being narrow-minded ... I see critical thinking as being more of a practical, or systematic, way of organizing or making a hierarchy of ideas or concepts or strategies or whatever; whereas (I would just guess that) higher order thinking is more exploratory." Asked about recent insights, the reply was, "I've learned how important willingness is in the whole process. [The students] were, for the most part, forced to take this class, and a lot of them were doing a BA in a program that's very much based in psychology. So I got to experience firsthand the resistance – there was resistance, there was anger, there was confusion (in both courses)."

Topics in both courses included critical thinking, critical dispositions, transformative learning and epistemology; metacognitive self-regulation and self-regulated learning were not dealt with in either course.

Higher order thinking is recognized as, "The ability to not immediately prejudge every situation, person, concept … It's also … when people have these theories, and they make them concrete … I've seen educators act out theses theories, the theories have been internalized. And I think that's brilliant." The most effective ways to teach and learn higher-order thinking are, "[M]aking it as relevant as possible …I've found that if I can get an idea that is pretty complicated, and then make like a cartoon of the idea, pare it down, and then explode it again to make it a part of everyone's life. That's something that sticks. That works ... So that's not just intellectual, it's feelings. So if you're getting them to make a connection between these things, it works." Also, "I ask a lot of questions."

Both classes produced some favourable results. In one class, "One of the students ended up creating a scrapbook ... compiling different articles on reasonable accommodation from different newspapers ... and handed it over to [the instructor]. He just did it out of interest. I thought that was remarkable." Also, one student provided evidence of a cognitive transformation; this person had spent most of the term seeking hard information (the "right answers"), but shared at the end of the class the realization that the right answers will not always be available. In the second class, "I definitely had a few students at the end who came up to me, and they were really, really happy. They wanted to take more classes with [this instructor]." However, there were some unexpected difficulties; for example, it took a long time for the assistant to get the class to realize that historical facts should not be counted as a text's "main ideas"; distinguishing facts from ideas proved to be a difficult lesson for some of the students.

Interview G-9. Final Interview, Instructor 1, Courses 1 and 2

At the end of the year, it turned out that thinking outside of the box, to challenge authoritative conclusions, was not a matter of habit for the students in the two courses taught by this instructor. "For the two courses, I continuously had to remind the students, the preservice teachers, to think critically. I think that it's not like a one-time process, you talk about critical thinking, or higher-order thinking (as you call it), and that by a certain week, or a certain class, they would start doing that. I guess it's so engrained in them to be in the box, and to follow the tradition, that it's going to take some time, not just one course, but many, many courses."

Results varied quite widely. "I did set some expectations and some standards, and there were a number of them that came up to those standards. And that's what my goal was; to at least make some of them think critically about some of the issues (if not everybody about all the issues)." In particular, "The first of the standards that I set for all my courses is to think critically about the Self, or about themselves, some of the practices that they follow or some of the things that they've been doing. I was quite happy, and quite impressed, that a number of them did actually start questioning some of the educational philosophies that they've been following, or some of their beliefs, some of the things that they know. They started questioning, how did they know them. Another thing that I was very impressed with, especially in the last course, was that a few of them got into conversations with each other, and this was across classes, across racial identities, across cultural identities ... That was really one of the things that I have been looking for in my courses, that they should start talking to each other ...Rather than going with the flow, they really thought, and they chose things to write about that were out of the box, that were very critical. Critical in the sense that they were critical of the system, they were critical about the way philosophy of education is done with the philosophers we usually use; they were critical of that. That was a positive outcome ... Some of them really came up to what I was hoping for." Of course, "There was the usual number of students who just took it like any other course, sat through it, borrowed notes from others, wrote hasty papers ... I would say 15, 20 percent." With regard to developing autonomous and higher-order discourses, "About 60, 65 percent started thinking on their own … the test of it is when they start questioning themselves, and their assumptions, some of their beliefs and values. Why have I been thinking like that? What is the source of that? That's what tells me that I've been successful, and at least making some of them challenge their assumptions or fundamental presumptions."

Student evaluations were gratifying. "I got my course evaluations, especially the written comments, and they were very pleasing. Those comments told me two things: they were pretty happy with both courses, those who actually took time to write those comments. The second thing is that, looking at enrolments for the course this term, and a number of people who were in the [Course 2] are now signing up for the [Course 1], so that means that they at least got something out of that … because this is not a compulsory course."

One success was the creation of a "safe space" for people to express their ideas without fear of negative consequences. "A number of them pointed out that they were initially surprised that they could talk, and then they were encouraged because they found a space where they could freely and openly talk."

Epistemology was not covered specifically, but "what we were talking about, in terms of ways of thinking, and challenging those ways of thinking, that is epistemological." In addition, the traditional notion of 'objective truth' was discounted, and this was important because, "I think that's what was emancipatory in those courses. Once everybody understood that … each one of us has our own ways of knowing what's true, I think that's what really gave them the confidence to come out and speak their minds, or say whatever they wanted to say, and that kind of led to the creation of a safe space, where they could talk without fear of retribution."

Challenging the students to think outside the accepted norms was a successful method. "The more uncomfortable that we are, the more that we think, and the more we try to come to grips with how to change things. … what is called the pedagogy of discomfort … there was this session when I talked about how colonialism has affected the teaching of philosophy of education, and how it has undermined a vast body of knowledge which is totally discarded in terms of consideration as a philosophy of education. I think that really spoke to some of them …I wish I could show you some of the papers that they wrote, some of the topics that they chose. Especially the biographical papers, they really showed that they were discomfited to really think outside the box, and to really think about the self (what some qualitative researchers would call 'confessional' papers). Those are really very brave papers that could only result from the pedagogy of discomfort."

Critical thinking, critical dispositions, metacognition and self-regulation were not specifically discussed in these courses, according to the instructor. When asked whether the topic of transformational learning was discussed in these courses, the instructor replied, "Yes … in both courses, more in the first than the second … We did talk about them, but whether I could see any effect of that … I wouldn't want to gauge how much … I don't think one can."

Interview G-10. Initial Interview, Instructor 2, Course 3 (Educational Psychology)

Instructor 2 was a doctoral candidate in education, with a degree in psychology, who has had extensive teaching experience (about 18 years) at the post-secondary level. The intention for the course was, "[To] stress the limitations of focussing only on what's in the textbook, or focussing on what's in a lecture … have them think about the material, rather than have them restate the material to me … to go beyond the information, to try to think of new ideas, to come to new conclusions about whatever's being covered in the class, or in the textbook. I value creativity highly, and tend to favour students who are very creative with their responses, but who can support that creativity. So somebody who comes up with an idea, or a solution to a problem, or an idea about a concept, and they try to expand on that idea – if they can defend their idea, or what method they're using to expand on that, then I'm highly impressed. That's probably what I value the most …I try to develop the ability to synthesize information, so in this case they're not really coming up with a new idea, but trying to incorporate all the existing ideas, and we do that numerous times throughout the course, through the writing of a paper, through online discussions where they have to synthesize the ideas presented by others into one uniform post in the end."

Higher-order thinking is recognized by, "[E]vidence that there is a deep understanding of the ideas being presented by being able, easily able, to defend what they've said." Teaching and learning higher-order thinking requires "Many avenues of communication. So I'm always available, I always respond immediately to emails, office hours are flexible … I try to encourage communication between each other so that they can have that social dialogue going on within groups. I set up small groups, in an online environment that work in small groups, and in the classroom as well … It's dialogue and communication." Also, "Experiments; we do a lot of experiments. I present ideas; we then discuss those ideas. In some cases there'll be a demonstration where I show the material, or an experiment, or a demonstration, and then we talk about it. … I usually try to have them work on activities where the outcome is not predictable … I'll often bring in newspaper articles as well, and have them evaluate the content of the article."

Critical thinking and epistemology are subject matter for the course, as is metacognitive self-regulation. "We reflect a lot in the class, so I have them come up with an answer, or read a portion of the text, or respond to a post, or complete an assignment (or what-have-you), and then to consider (not in a formal way, but to consider): has this matched your learning goal? Is this where you wanted to be? Is this what you wanted to learn? Is this the way that you wanted to learn it? Where do you feel that you could have improved?"

Based on prior experience, students are expected to be poorly prepared to engage in complex cognition. "[T]hey come in expecting to be lectured and given information, and to be tested on that information in an exam. And they will rebel when they find out that that's not the case."

With regard to expectations, "My greatest hope (within teaching and learning!) … is that these learners are going to leave the course with enough interest in the area and the subject matter to pursue it on their own. To continue with the ideas in the course, and to incorporate that material in other courses, so that it becomes part of them, as opposed to something they have done and then left behind …my biggest fear would be that they get nothing from it. My second biggest fear would be that they do get something from it, but apply it only in the context of this course … I think that would be terrible. But if they say, 'This is what I need to do to succeed,' and it changes their behaviour, their way of thinking, so that they can apply that same way of thinking in other courses, and other subject matter areas, I would be very, very happy."

Critical thinking and metacognition were topics in the syllabus of this course.

Interview G-11. Student G, Course 3

Student G (who is studying early childhood education) named empathy, as well as critical and analytical thinking as important thinking skills. This respondent referred to self-confidence, adaptability, flexible thinking and patience (dispositional aspects of learning). "I think that you should understand both sides of every problem to find a good middle ground." Metacognitive considerations were also mentioned, as, "Just be aware of your own natural reactions to certain situations, so that you can keep those under control. Maybe you don't always have the best reactions to the students, but you have to be aware of that … The best understanding of something comes from knowing one side, and the extreme opposite. And you usually find that answers to questions lie somewhere in the middle of those two. I think you have to be flexible in your thinking and open to considering the total opposite of what you already believe."

Evaluative judgments are not a priority for this student, but they were nevertheless acknowledged as relevant. "I believe a lot in intuition, so as far as evaluating consciously goes, I don't really believe in that. Although, I guess, higher-order thinking would require that."

The educational psychology course was informative with regard to metacognitive self-regulation. "Coming in to this course I was never the type of person who regulated anything. I never had an agenda, I never had deadlines which I created for myself, I never proofread anything I wrote. I always did well, but now I'm doing even better, picking up on some of these tricks; set goals for yourself, and specify how you're going to implement your intentions, and follow through to achieve that goal … I think it starts with a general goal, and questioning yourself on how you're going to get to that goal. I know a lot of the emphasis in this course was on knowing your own abilities, and with that in mind, pushing those abilities, constantly working on them to grow and to develop your mind and skills. …And especially as a future teacher I would want to emulate those practices so that my students see how they should go about achieving their goals."

Topics, according to this participant, included critical thinking, metacognition, and self-regulated learning. While transformative learning was an unfamiliar idea, Student G's reaction to an explanation of the topic was insightful. "You can't force somebody, you can't inspire somebody by showing them something and then expecting them to grab hold and make some drastic change."

Asked about how to teach thinking skills, "I believe in the modelling theory a lot, that's good. I think if I show my students how I regulate my thinking by thinking out loud, that would help. I believe in giving reasons for everything; I believe that empathy goes beyond emotions, I think empathy goes for thinking as well …The best way to teach somebody between right and wrong isn't just to set it out in black and white, but to explain why this would be wrong and why this is right, so they internalize that."

Student G participated in the online discussions in a perfunctory manner. "I just wanted to go an give the shortest answer possible and get it over with … because I had to … maybe once a month." It was not considered a valuable experience, because, "we discussed things very thoroughly n class, to the point of exhaustion. There was no need for me to go online and do it again." Furthermore, "everybody was doing the same thing, just posted the shortest possible answer." Asked about the moderator, Student G replied, "I wasn't aware of a moderator."

The greatest challenge to learning higher-order thinking is the classroom environment, "because in school you're trying to regurgitate information the way that you know it will be accepted by your teacher. The greatest challenge would be thinking critically and independently for yourself at the same time as you try and perceive things the way you know your teacher is going to perceive things. Then you reiterate that so you get a good grade."

Interview G-12. Student H, Course 3

Student H, an artist studying art education, wants to teach "cross-curricular subjects through ... art understanding and art making." This participant felt that the following skills were important for higher order thinking: holistic, critical, spontaneous, group thinking, emotional thinking, transformational thinking, aesthetic thinking, and sensory thinking ("thinking that relies upon the senses in order to render a cognitive assessment or judgement about something"). In addition, "relatedness" was also named as an important dimension: "You have to be aware of it. Sometimes it a subconscious thing; sometimes you're just subconsciously related, but when you're aware of that relatedness, it's that buffer zone again between the cognitive and the emotive; when the cognitive side is aware of the emotive side, it's a sort of meeting point ... Respect is very important. That allows for relatedness."

As for metacognition "Thinking about our thinking? It was discussed in the course, sure. But the entire course was not spent talking about that specifically. ... [Metacognition is] very important. You have a young person needing to know how to think about what they're perceiving ...But if you offer them other alternatives of how to think; for example, say a student is working on something and you can perceive what they're doing, and you say, 'This is interesting; you approached it that way. Maybe this student over here approached it this way' ... So that sort of introduces to them the notion that a variety of thinking skills, or an awareness of that variety, is a higher order thinking skill. So it's very relevant."

Student H identified critical thinking, critical dispositions, metacognitions, self-regulated learning and epistemology as course topics. With regard to epistemology, "Knowing does involve truth ...I can't explain why, but truth to me means light. Knowing involves light." Self-regulated learning involves evaluating the source of information ("Where's it coming from? Who's delivering it, and why?"), and assessing its usefulness ("How could I possibly use it in the future and in the present context: how could this be useful? ... What context could I possibly see myself where I would be using this?").

When asked about the most effective ways to teach and learn higher order thinking, the reply was, "By diversifying the material, and the way that it's presented, as much as possible. Make it fun. When it's fun it's more easily absorbed, and you can think about it afterwards .... In teaching the arts, I rather like the idea of a solution that's not finite ... The students all understand from the getgo that there isn't one solution, there isn't one person that's going to be right. There isn't one right answer, there are many different ways to approach it ... The focus is not so much on the product ... but more on the experience of making-learning."

Student H posted once or twice to each online discussion topic. The experience was valuable, "Because the method of communication was different, therefore the information was different ...I'm not sure if it's better, or faster, or slower. I would just say it's different; it's like a different spice in your spice cabinet." The moderator "was there to answer our questions, and to help when the professor was not available."

Challenges to higher-order cognitive development include, "Peer pressure; you don't want to come off as the smart person in a particular group." Another difficulty is, "Associating the material; transferring it to different situations."

Interview G-13. Student I, Course 3

Student I is an independent student who would like to become an English teacher; when asked the meaning of higher order thinking, the reply was, "Metacognition. Thinking about thinking, taking in the information, and then ... make your own ideas about it." Higher order thinking is recognized by "good arguments." The most important thinking skills in education are, "To be able to think on your own, and not take whatever somebody's telling you to teach the kids. You don't just take their word for it, you have to be able to go and find out on your own what's good and what's not." As for critical dispositions, being open-minded was cited as being important.

Critical thinking was identified as a topic of the course; however, "We didn't really learn about thinking. We were always discussing everything in class, but we weren't talking about how to think." The most effective ways to teach and learn how to think better were, "Discussion. And research. Reading and doing a paper. That's what helped me the most."

For Student I, knowledge is about truth. "Isn't that what everybody wants to know? The truth, knowledge ...This is what people want to know, right? They want to get to the truth."

With regard to critical and higher-order thinking, "I'd say we never talked about in high school, or elementary school. Now it makes sense. Maybe we should have been taught about it, or maybe somebody should have mentioned it, or we should have been trained into thinking about it on our own, instead of just waiting for someone to tell us the truth. Now that I'm here, through life I realize that maybe the truth isn't necessarily what everybody else tells you about."

The online discussion forum "would lead to more higher-order thinking, because you would have to explain your point, and then somebody would disagree, and bring counter-arguments, and then you have to bring more counter-arguments, and do your own research about it." Student I posted regularly to the discussions, several posts for each topic. The moderator "provided good insights, or if the discussion wasn't going in the right directions, or if we didn't bring up an important point, [the moderator] would bring it up." Two or three people in this student's discussion group participated, while, "some people were just silent."

Interview G-14. Student J, Course 3

Student J is completing a degree in English literature, and wants to become a teacher. Higher order thinking meant considering alternative views. "When you think about something, it doesn't help to generalize, you can involve a lot of things. I'm thinking of something, I can generalize about it, and then from there eliminate what I think is not that strong, just what I strongly agree with. Compare it to how other people see these things." Asked about the relevance of philosophy of knowledge to higher order thinking, the reply was, "There has to be some proof."

Critical thinking, epistemology and metacognition were recognized as course topics, as were self-regulated learning and transformative learning. Metacognitive self-regulation was described as "Thinking about thinking," and self-regulated learning was considered as, "... [M]onitoring yourself, on things that you are doing." About critical dispositions, "You have to be positive, you can't be negative; also you shouldn't be one-sided." When asked to describe higher order thinking skills, the reply was, "I have to apply my understanding. I have to break it down, then start analyzing it ... Pick out the facts, what I'm looking for. Identify what I'm looking for. And look at the things that I don't need for that subject matter and try to understand why they don't fit in." The most important thing about higher order thinking was, "Don't be biased."

Student J, while aware of the online discussion forum (and of the relatively few participation grade points associate with it), did not participate in this assignment at all. "I was overwhelmed by my personal life, and the other thing is that I'm not an education major, I focussed more on my main course of study."

Interview G-15. Teaching Assistant 2, Course 3

The teaching assistant for educational psychology moderated the online discussions. For this participant, higher-order thinking includes, "Being able to comprehend something, first of all. Then to apply it to different contexts, to think about it critically, and then make your own ideas about [it] ... To be able to self-regulate, to know what they're understanding and not understanding, and be able to read more, or ask questions, so that they're capable of comprehending what they're supposed to. And that applies to becoming a teacher as well; because if they're not responding to the context appropriately, like if they're not having an informative dialogue with their students, then they're not going to be able to teach them accordingly ... They have to be able to read, to process what they're reading, and synthesize it in a way that makes sense to them ...Writing, also; being able to formulate one's ideas so that other people can understand ...If they used examples to back up what they were saying, or applying their reading to their answers. Answers that apply to the contents, rather than just an experience they had (or something like that) ...To be able to go beyond what was asked, and think about it a little more advanced ..." Asked which affective dispositions are important to thinking critically, the reply was, "A positive attitude, being able to attribute success to your competence."

Teaching methods that support higher cognitive development were applied in the course through "giving people lots of opportunities to learn in different ways, and to apply things concretely, rather than just reading and ingesting things and then just spitting it back out. There were lots of different activities: papers, tests, lots of ways that would draw out how people were thinking about things based on their own needs."

The TA prompted the students to examine their thinking processes. "I would like to enforce the metacognitive aspects of what we were doing, trying to get them to think about how they would formulate their answers, and why ... Asking them why. Where they're coming from, that helps." Modelling of higher cognitive activities was also used, as "There was one message where I went through and demonstrated how I would think about the question and formulate my own response, so that they could kind of see my thought processes, and experience a different way of approaching the question."

Metacognition was a topic in the course; however, "I don't remember a lot of discussion bout it in the forums. I do remember from talking a bout the exam – it was a concept for them, but it didn't really come through. We talked about it quite a bit before the exam." With regard to self-regulated learning, "I remember goals coming up quite a bit."

Gratifying results included the work of a student whom the TA assisted in preparing her term paper; that student worked very hard and produced a fine result. In the discussion forums, " I saw some improvement in how people responded to the questions. They learned more how to answer the questions. I'm not sure if that really involved critical thinking, or just learning how to manipulate the questions ... they were using better examples and complete responses, instead of just a sentence or two. But, there was a limited participation in the discussion forums." About a quarter of the students contributed regularly (about twice a month) to these conversations. The quality of the discussion postings was highly variable. "Some people would neglect the question, and just say what came into their heads. Others would regularly really think about the question, bring in examples from the literature, bring in examples from their own lives, reflect on other students' answers ... then after other students had responded to them they would respond again to that student, so they were thinking about what they were saying and then responding." Students also engaged in less formal conversations through the course's online conference.

Lessons learned included how to do a better job in moderating online discussions. "I didn't want to give things away, or impose myself on the discussion. Which I'm not sure, looking back, was the best strategy. I would be passive until the deadline had passed, sometimes, and then offer my take on things, and respond to what people had said. Had I been more active right from the getgo, it could have helped students and encouraged more students to participate (instead of letting them figure it out on their own)."

An interesting result of the process was described as follows. "I think it taught the students that everything doesn't always rely on getting a mark for things. [The discussion forum] was an opportunity for students to think about something, to think about what they're learning, and apply it in a way that wasn't going to be graded, so they could really concentrate on the quality of their responses ... it seems that they were motivated in a different way."

Interview G-16. Final Interview, Instructor 2, Course 3

This instructor had a particular strategy for covering the material in this two-semester course. "I decided that I would bring up the main ideas in class, in lecture format, and try to engage the students in some sort of discussion, to make sure that they understood the main ideas, to see if there were any misconceptions, or if anybody had some great ideas ...Could they link it to something else that they studied, or to some personal experience; anything that would help them retain the information and link it to what they already know ...For the most part it was a successful strategy. In some cases ... it was difficult to determine whether all of the students were cognitively active ... One of the things that I love to do is to present material that is ambiguous, or make some sort of statement that is potentially false, or a misconception, something that people will commonly believe that isn't necessarily true." Other times, "I decided to get them to vote on ideas every so often …I would say, "Here's this idea, this statement; do you disagree or agree, why or why not?' … I found that they got really engaged, and I think it was because it was a bit of a competition and a game. They appeared to enjoy that."

When I asked about specific results, I was told, "I had one student (in particular) who continually amazed me. She always questioned the material …she also had evidence to back up her statements. … So she would … bring in the ambiguity to the results, or the conflict in the results … She was excellent – she inspired a lot of other students, I think, to contribute as well, because she was brave." However, "There were bunch of coasters that did very little." Most of the class (about three quarters of the students) was neither very brilliant nor very dull, while the rest were split at the high and low ends of performance.

In future courses, "I would design more in-depth discussion, rather than more discussion. The mistake I made this year was to have too many discussions on too many topic areas …It would have been better to pick out a few key ideas and let the students explore those key ideas and then bring in other ideas naturally, as they occur, rather than saying, "OK, now we're going to switch topics … I would instead bring in a series of small quizzes in the multiple choice format that they feel comfortable with, maybe once a month …Then we could devote all of the other learning and assessment to more substantial ideas beyond the factual stuff … I'd like to take away the focus from just learning factual information for the exam."

Desirable cognitive skills were described as, "The ability to take ideas and dissect them … to be able to evaluate them, and to discuss them, and defend them To come up with an idea, know why you believe that that's your idea, and to be able to defend your position. That's what I tried to promote." Questioning methods were used "all of the time. And I insisted that they support their responses with some sort evidence; research, or whatever they could, so that they had to be able to say, 'This is my conclusion, because …'

Dispositions were relevant, as, "The student that is more willing to be open-minded about different ideas, than the student who is more of a believer in there's a truth and a non-truth … there were some students who believed that there was only one right answer, and what is that right answer? And they would sometimes get frustrated in class, because we would say, "Well, it depends." And they wanted to know: "No; what is the answer?" Then you would see other students who looked at knowledge as a more infinite area. These students typically did better, of course." Also, the willingness to engage in discourse was seen as important. "You have some students who are questioning the ideas, but if they can't verbalize them, they can't test them."

Self-regulated learning was dealt with extensively. "We … discussed how learners need to set personal learning goals, ways of achieving those goals, trying to achieve those goals (the methods that they use), and to evaluate whether they had achieved the goals or not … So a lot of evaluation, a lot of re-evaluation, a lot of reflection, and a lot of testing of their ideas. We spent about three weeks, actually, on self-regulated learning. The students were asked to complete a perceived competence survey …I spent a lot of time trying to teach self-regulated learning, the steps for self-regulated learning, and I think it was successful." This work was apparently quite effective, as "I noticed a real change in how they conducted their discussions after that. The way that they presented their material; there was a lot more evidence-backed statements. I truly believe (and, of course, it could be just my own bias) that it helped them." When asked to evaluate the effectiveness of their learning strategies, some students admitted that they were not satisfied, but when asked what they could do to improve their methods, some balked. "The things that they've done ineffectively for so long, now that they've recognized that it's not effective, how would they change it? Some really don't want to bother with that. They want to stick with their own method, even though they do find it ineffective."

Epistemological sophistication was also covered, although, "I didn't use those terms." The instructor did discuss, "What is learning for you? How does your belief of what learning is affect, or impact, on the way that you learn and the results of your learning. Then we tied that into the students who believe that learning is finite versus those who believe that learning is infinite."

Critical thinking, metacognition, and self-regulated learning were topics that were discussed., and deep understanding was emphasized throughout the course. "I really wanted to emphasize, not so much the 'what' of the material that was presented to them in the class and in the textbook, but the 'how.' How did the researchers come up with this idea? Why do you believe what you believe? To get beyond the facts, to justify." Experiments, which included gathering and interpreting data, were assigned, which allowed the students to deepen their experience of educational psychology in action. "I think that that was a great benefit ... because it did allow them to evaluate and think about what they were seeing and how they were interpreting that. And how others were interpreting it, and how it was different ...I also wanted them to see that the theories presented in the text were not quite as simple as they appear ...I wanted them to see that this could be very complex."

There were some disappointments. "For some of the students this demo didn't really work out as planned ... there was a small number of students who wanted me to present the material that they need to know, and would say: 'Instead of doing this, could we just have a weekly quiz?' To see whether or not they knew the material, in preparation for the final exam. 'What do we need to know? Will this be on the exam?'" Also, "I would have loved to be able to reorganize the class, the furniture and the structure, so that we could have more small group discussions, more activities. I found the layout of the classroom to be a little bit a little bit of an obstacle – occasionally we would have small group discussions, they would kind of debate them, but it was difficult to do it."

One of the best results was students', "Being aware of their learning. I think that was probably the most valuable thing in the course for them. How they learn the material, how they learn a subject area; how they build knowledge. Questioning, just questioning." Also, students came from different academic specialties, allowing for a useful variation in ideas. "I wanted to emphasize that; emphasize the different perspectives. So we would bring up different theories, and try to discuss them from these multiple perspectives. How would a sociologist think of this? What would an economist say? How does this theory relate to your area of interest? ... I'm very happy that I did that. I identified these different backgrounds and I emphasized it, so that they could see these different perspectives. I think it also had an impact on their self- esteem, or confidence in the course, in that their opinion (even though their perspective is different from others) is important."

In future courses, "I would have a bit more online stuff, that I didn't have as much as this time. I did have some, but not as much ...they had a few discussion questions, but I think they were pretty overwhelmed with their other courses, that didn't really take off. So I'd like to figure out a way to allow it to take off a little bit more ... I would offer additional quizzes (that I didn't do this time), just so they could feel, like a knowledge check ...They were concerned that they weren't being tested enough."

The most important thing that this respondent learned was, "That some students are very resistant ... [T]he A is the most important thing – any way that they can get that A. Some of them feel very comfortable with: 'Just give the material, tell me what I need to know, and give me the exam. That's all I'm really interested in.' They're just not interested in the process, and what they're going to take away from the course in the end.

Interview G-17. Initial Interview, Instructor 3, Course 4 (Philosophy of Education)

Instructor 3, who was teaching for the second year (after receiving an undergraduate degree in philosophy and a doctorate in education), planned to support and encourage higher order thinking in this philosophy of education class, but did not intend to spend time talking about thinking processes. "The critical thinking tradition in philosophy of education is a strong one; there's a lot of people that work in that field. I'm not really one of those people ... I think that there's a tremendous amount that we don't know about thinking."

It was projected that emancipative learning, and learning strategies, would be discussed as subject matter. Planned course topics also included teacher neutrality, multiculturalism and indoctrination; the instructor suggested that these would be fruitful areas for stimulating cognitive activity. "We certainly are going to be dealing with what you might call higher-order thinking ... in the second half of the class we're going to be looking at contemporary controversies in education ... [W]e're going to be looking at different perspectives in education, asking the students to sort out these different perspectives ... We also have two perspectives on multiculturalism that we're going to be looking at, so that should be an interesting debate ..."

This instructor follows Dewey in encouraging students to think critically, defining the process with some diffidence: "Higher order thinking is distinguished by deliberate and systematic effort to work through a problem ...That would be my definition. Is that a good definition? I don't know. Would it hold up? Who knows?" When asked to describe the most important thinking skills, the reply was, "You question received assumptions, you examine the premises of an argument very carefully, you actively look for new ways of seeing."

In addition, "Thinking skills are certainly going to be implicit in the curriculum, but not explicit. There is going to be virtually nothing that's dedicated specifically to critical thinking. ... however, hopefully this class is designed to get students used to different ways of thinking about education, to get them to think carefully about controversies in education, and hopefully in that way their critical thinking skills will develop, their educational assumptions will be destabilized. That's my goal." However, this is not to say that it's always a mistake to discuss thinking. "It's fine to talk about critical thinking explicitly, especially if you're an educator, because we need to think about these things; how do we foster critical thinking skills in young people … I prefer to do it implicitly. So I prefer to get them to think about educational controversies carefully, and in that way foster critical thinking skills, as opposed to talking about critical thinking specifically." As for the critical dispositions, "We foster critical dispositions by enacting the kinds of activities that would lead towards those dispositions in the classroom."

Epistemology is "Not a priority for this class … I'm not convinced that epistemology is really going to fire up these undergraduates. This might be the first class they've ever had in philosophy, so I want to try to keep things as close to the ground, educationally speaking, as relevant to classrooms, as possible." As for the possibility of discussing transformative and emancipatory learning theory, the answer was, "Yes. Maybe … It all depends on what we mean here by transformative learning, emancipatory learning … I am going to talk about how Dewey wants to liberate students, how Dewey wants to create citizens who are powerful actors who can help create a new society. I'm going to talk about the problem of alienation in Marx; I'm going to talk about how that problem transfers over to schools, and what we could potentially do about it." Social learning is a topic of interest, but not a centrepiece of the course. "We're going to talk about it with Dewey, certainly … I have them reading a couple of period pieces about nineteenth century education which are absolutely horrifying, and so (by contrast, I think) we'll emphasize the value of collaborative learning. It's not going to be a specific topic of conversation, but it will probably come up."

With regard to teaching methods that facilitate higher order cognition, "What doesn't support higher order thinking are memorization and regurgitation tasks. There's no way that I would get the kids to write a multiple choice test about great philosophers of education and what they thought ... So I'm going to try to get the students to do tasks that are fairly conventional, reaction papers, essays, which pose questions that get them to reflect, that get them to say, 'OK, is this guy right or not?' … So I try to ask them questions that get them to reflect, that get them to really dig in, and think carefully, and compare opposing viewpoints."

Finally, we discussed the learning objectives for the course, and the instructor's expectations. "Getting students excited about the history of education, and getting them to understand the history of education. The second part of the class, I really want them to think carefully about education; I want to destabilize their assumptions about education. I mean, what should education look like? This is a really big question …So I want these kids to think adventurously about education, and that's what the second half of the class is designed to do … I'm hopeful, but, the first time through, teaching a course, you make mistakes … My emphasis is 'How do I learn from my mistakes? How do I improve my own practice here?' That's what I've got to do; I'm pretty new to this, and although I've taught before, I have a tremendous amount to learn."

Interview G-18. Student K, Course 4

Student K wants to teach theatre and English, and is studying creative writing. Asked about specific skills or dispositions associated with higher order thinking, this participant replied, "In my mind, the only way to learn something complex is to engage with it critically until you understand it. I was working at a tutoring centre last week, and the kids do not know how to engage things critically. Or, they just don't want to; probably because they didn't know how to. They don't know that it can be pretty neat

…that it can bring you a lot of interesting things. So they just didn't get it … For me, in my own brain, critical thinking involves engaging with a subject, looking at different sides of it, contemplating implications of each aspect, and ultimately coming to some conclusion in which it fits coherently with my view of the world." Self-evaluation was named as an essential cognitive skill for this purpose. Important dispositions were, "Curiosity. A passion for learning … If you don't have a tenacity for learning, then you're not going to learn much."

With regard to metacognitive self-regulation, "I would define it as being aware, thinking about thinking. If I'm in a particular train of thought, it's being aware of what factors are influencing that, and ultimately thus step out of that in a rational way. To be able to look at it rationally." In response to a question about the relevance of philosophy of knowledge, the following questions were posed: "What is the universe, that we feel that we have knowledge about it? And how is it that we can decide what's really important (which is really more of a sociological question)?"

The most effective ways to teach and learn higher order thinking are, "Through discussion. At the tutoring centre, the kids would come in and be like, "Oh, I hate [the main tutor] so much. She's such a skank." And I would say, "What about her? Why? Did you find that to be bad morally? Socially? What exactly is wrong with it?" And I would really ask them questions, why, and why, and why? And they got really excited about it, to the point where the next day one of the kids came in and asked, "Do you think the truth is subjective?" And he had clearly been thinking about it all the night before. It was really neat." Also important: "Providing really good readings. One thing that I thought was interesting that the instructor did was, he made it clear that all of our evaluation was going to be based on engaging the text critically, which [laughing] incited a lot of interest in doing so, even for people that wouldn't normally think of doing so."

Student K named critical thinking, epistemology, metacognition, self-regulated learning and transformative learning as topics in Course 3.

Interview G-19. Student L, Course 4

Student L has a degree in political science, is studying for a BEd in teaching English to second-language learners, and recalled having learned that higher order abilities (understood as the ability to solve problems, and to "figure things out") start around grade 5. This participant recognized critical thinking and critical dispositions as topics of the course.

When asked about specific cognitive skills required for higher order thinking, this student replied, "To figure out the problem." Relevant dispositions were a "more developed attention span. You need some form of discipline – you have to know how to …work things out on your own. Creative. The drive to learn, to go further than just what's there." The most important thing to know higher order thinking: "It's problem solving, finding the solution, different alternatives, creatively." Teaching and learning thinking involves presenting a problem, and providing guidance (or allowing students to work independently, without guidance). Evidencing a delicate balance of a paradoxical objectives, this student wants, "To give [students] more autonomy, like how they're going to do it. Give them more choices … but you give them a structure – you tell them what you want, and you want creativity."

Critical thinking is seen as one of the qualities of higher order thinking (along with problem solving and creativity). The disposition to go beyond basic ideas, and to think autonomously, were said to be important, while metacognitive self-regulation was viewed as a set of strategies for organizing one's planning and regulating the workload. Self-regulated learning was not a topic in the course, "but as a student, it was in there in everything." With regard to understanding knowledge, several types of knowledge were named (memorization, life experience, spiritual knowledge), and 'truth' was seen as universal and objective, but very difficult to recognize, as, "I believe that there is one truth, but whether I know it or not? I don't know."

Interview G-20. Student M, Courses 2 and 4

Student M wants to teach and perhaps (eventually) do administrative work in education. For this participant, higher order thinking is, "Thinking where you already understand the basic concepts and you have to apply them within a practical context, " and it is recognizable when students' comments "demonstrate that they clearly understand the concepts, and beyond that, their comments generate new knowledge, or something beyond the basic definitional understanding of the concepts." Higher order cognitive skills include, "The ability to think abstractly; the ability to think creatively, to imagine scenarios, and bounce hypothetical situations off of those."

When asked what dispositions are important, the reply was, "Academic curiosity, which I guess ties in with motivation. You have to want to delve into a topic, you want to explore it. It's not a passive process."

Higher cognitive work "takes practice, repeatedly putting yourself in that situation, in order to analytically break down a problem … Higher order thinking involves stepping outside of your mindset and representing other opinions, or imagining other opinions (which ties in with creativity, and empathy, the ability to foresee or imagine someone else's position, in order to explore alternate scenarios). Ultimately thinking critically is matching up different mindsets, opinions, or philosophies one against the other."

This student pointed out that it may be very difficult for students to understand the various rationales which underlie complex theoretical frameworks, and the ways in which these ideas interact with each other. Effective ways to teach and learn cognitive skills include "a model where a teacher describes one particular viewpoint, describes the logical structure of that viewpoint, and then offers an alternate viewpoint, and once again structures that viewpoint. …The discussions also have to have certain ground rules. One of the problems with discussions in class is you get a lot of opinion with very little support. Just because you don't have a textbook, or you don't have a lot of knowledge, doesn't mean you can't support your argument on a logical basis, offer logical support for your arguments." However, "I don't think it can be taught. Taught seems to imply something almost forcible. It's through doing essays, through seeing … a logical explanation of a person's perspective. It's modelling, and it's practice."

Instructor feedback is seen as an essential coaching tool. "The advantage of an essay vs. a classroom scenario is you get to sit down and formulate your thoughts, and you reflect more on the logical basis of your argument."

This student sees critical dispositions as related, but secondary, to a learner's motivation to succeed. "Motivation is essential, but not necessarily attitudes. You can have people kicking and screaming yet able to think critically to do their essay, as an external motivation ...It's a reward system. Pragmatics. Either way, intrinsic or extrinsic, I think that motivation is the key factor." Philosophy of knowledge "could be" relevant to higher order thinking: "When you're dealing with critical thinking, you have to assume a certain fluidity, a lack of empirical truth. You're entertaining multiple perspectives ... you can have a couple of seemingly contradictory perspectives which may both be valid, according to the person's conception of it ... The truth is fairly fluid ... I don't believe in empirical truths, really; a lot of the subjects that you can engage with critically, those subjects, the reason we can engage with them critically is that there aren't that many empirical certainties."

Course 2 topics were seen to have included critical thinking, epistemology and self-regulated learning; Course 4 included critical thinking, critical dispositions, metacognition and self-regulated learning.

Interview G-21. Student N, Courses 2 and 4

Student N is in the BEd program, and wants to become a pedagogical counsellor for young children. Higher order thinking means, "to think critically, and based on experience and knowledge ... And apply it, use it in daily life ... The processing of information. Not just memorizing it." Important dispositions or attitudes in the process of higher learning were motivation (the desire to learn, including high expectations for one's own learning), and the capacity to change one's mind. "When someone is motivated, they find a way to process information much better, and use it much better" Asked to name specific cognitive skills, this participant recalled analysis and synthesis (having learned Bloom's taxonomy in a prior class).

According to Student N, Course 2 topics included critical thinking, critical dispositions and self-regulated learning; Course 4 included critical thinking and self-regulated learning.

The most important thing in teaching and learning thinking skills is, "The subject must be interesting. For example, teaching mathematics to young children, or high school, the teacher should find a way to make it more interesting. And when it is more interesting, the children can comprehend it freshly, comprehend it in the best way ... [and] Asking them questions. Make them ask questions of themselves ...Provide them a process of learning where, in each step, they see a little bit more complex situation or subject, and step by step they learn how to use their mind to process more complex information."

Philosophy of knowledge is relevant to the process because, "When someone knows what this process is, and how knowledge is constructed, they can manage it and do it much better."

Interview G-22. Teaching Assistant 3, Course 4

The teaching assistant for Course 4 was pursuing a Master's degree in Educational Studies. Higher-order thinking is critical thinking; however, "the current use of the *term* 'critical thinking' as something that can be performed and practiced as a regular 'skill' without context/knowledge is problematic and somewhat misleading...people want to 'practice' critical thinking separately without considering the importance of the necessary background knowledge needed to do this in a meaningful way." Offering a definition of the term, "My own personal definition would be the ability to analyze a situation thoroughly (with knowledge of the content, good knowledge of what you're looking at), and to look at opposing points of view, and draw rational conclusions based on that." Dispositions were also seen as crucial, as "Being open-minded … the idea of accepting that you were wrong. If, at the end of the whole process, if you find that what you've discovered goes against what you previously knew, the willingness to face that fact."

Critical thinking, critical dispositions, epistemology, metacognition, self-regulated learning and transformative learning were all seen as topics in Course 4. Higher-order thinking is recognized when, "[S]tudents kind of stop and start to question things that they took for granted as being true before, and as soon as they start asking more questions, and looking for evidence to support other viewpoints." Epistemology was also an important topic in the course; a moment's reflection on its relevance brought forth this observation, "I think that if people are made aware of different forms of knowledge, or of ways of understanding knowledge, or determining what is knowledge and thinking about those kinds of things, then they're more aware of the process they're participating in …You have to take an argument through its full process." Self-regulative learning strategies were also mentioned in class ("How to read, how to prepare for a test …"). Transformative and emancipatory learning was also seen as important, as "I think of it as empowerment through learning, and transformation in terms of individual and social transformation through the learning process."

According to this teaching assistant, if students are to learn to think critically, they must be provided with both sides of an issue (and this is a problem for instructors, who may not always do this). In addition, instructors must model the process of examining the evidence and the arguments for both sides, and being open to whatever may result. "[P]eople take some evidence and some 'truths' (so to speak) and don't actually look at the other point of view, or the other evidence, in a serious way. They just kind of stop where they want to stop, and that's it. If you're really doing critical thinking, if you're really trying to engage in a critical process, well, you have to look at things you don't want to look at necessarily."

Teaching thinking requires engaging with the students. "I think you have to ask some questions; I think you have to make a link to something meaningful in their present experience. For example, if you're studying old philosophers -and I think [the instructor] was really good on this point - he really finds ways to bring it into a present context, to take the issue or the information that you're reading, and the questions that are being asked, and apply it to today ... Because if it's not meaningful … they won't really care, if they're not interested – it needs to contextualized in some sort of meaningful situation." Remarkable results were, "Seeing the students really change their opinions, and really questions things that they'd accepted as true. On an individual basis, that happened quite a few times …… I think the fact that the students loved the course generally … the reviews were really good; I think that was remarkable. Because (trust me), philosophy – when students hear 'philosophy,' there's really a fear of that word."

Interview G-23. Final Interview, Instructor 3, Course 4

In recounting the events of the semester, this instructor felt that "many of the lectures that I gave went well. They were successful both in terms of students coming to think more carefully about things in education: various concepts, various key authors in education, and they were successful at engaging students in a questioning/thinking process in engaging with these texts." However , there were also "...some significant failures amongst the readings, amongst the lectures that I gave." In addition, "A lot of people wrote good critical reaction papers. A lot of people got excited about philosophy of education ...The students (according to the evaluations) were almost unanimously pleased with the class (at least those who filled out the evaluations) ... People really talked to each other in the class (usually productively, sometimes not). My favourite part of doing philosophy has always been the discussions, and I think that we did have some good discussions in that class. That was probably my favourite part of it. That really did produce learning for some people." When asked what was the best results, the response was, "Getting students excited about philosophy of education, getting students thinking critically about philosophy of education, about how should education be."

The plan for teaching critical thinking implicitly was modified somewhat during the semester. "I guess I did talk a little more deliberately about fostering higher order thinking than I anticipated, because I did not anticipate that people wouldn't do it ... In this class, I had some students who just did not know how to follow my instructions ...I had to talk about that in a much more deliberate and specific way than I ever had to do before. I had to produce recipes for reaction papers, I had to show examples of students who had done it successfully ...Some students clearly did not grasp what I was wanting them to do ...There were some students who were far less prepared than I anticipated they would be, both in terms of thinking critically, and in terms of in terms of basic English language skills, which is a significant problem." On the other hand, "Some students exceeded expectations wildly."

The class discussions included "What does it mean to think critically about a concept, how we might want to escape indoctrination, how is indoctrination a problem? All of these things relate to the idea of critical thinking." The disposition to think critically was also described, as the students were told, "You have to be on the lookout. You have to be reading with a critical eye, waiting to pounce on weaknesses. This is in the finest tradition of philosophy ... A critical disposition is an important thing for you to cultivate." As for epistemology, "I was talking about how the Ideals are real in Plato's Republic. We had some points about social construction, too." In discussing the question of critical objectivity. It was noted that "This idea of being unbiased, of being perfectly neutral, is a very strong one in our society. It's normative in the sciences, it's normative among the judiciary ... Can a person actually attain this? And I think the answer to that question is clearly no. Did everybody understand that? I think that at least a few people got that idea. I think some people didn't really know what I was talking about when I was having this discourse about whether it's really possible to be neutral ...Certainly (hopefully) I did manage to persuade people away from this idea that true neutrality is a fact (at least)."

Having asked about lessons this instructor took away from the experience, I was told, "I've learned ...that the texts mean a great deal, the texts that one assigns. If the texts engage the students, it's a lot easier to get them to think critically about the texts, to actually care about what they're talking about. If I have to make great efforts to sell a text (as I did in the case of [author] I just don't seem to be able to get that far .. I also learned that sometimes a good visual is very important … sometimes visual representations can make a big positive difference."

Learning strategies were also discussed in class. "I was worried about the students, because even with my [other university] kids I definitely get students who panicked when they'd get to philosophy … It's completely different from reading prose; it's very unfamiliar. So I talked about learning strategies a lot; I talked about my own experiences as a college freshman when I first had to grapple with philosophy. I talked about how much difficulty I had with it; I talked about how much time you need to allow to process this stuff. I talked about how important it is to read it carefully … I provided them with [some] reading guides to try to shepherd them through [the most difficult] stuff successfully and stem their panic. I tried to anticipate some of the learning difficulties they would have and provide for them … I told them [about] skimming …. Some things you can just zip right through, just kind of grab the topic sentences and paragraphs, see what's going on. You can do that with some things and you can't do it with other things … I tried to communicate that. I don't know how successful I was; I would say that I had limited success on that front."

Asked to recap the most important things to learn about thinking, this respondent replied, "A disposition to question, an ability to construct dissenting arguments …A significant thinking skill is the ability to dialogue with another person in a civil, non-confrontational way … Explanatory skills, argument construction skills. Both of these are very important, and many of my students (it seems to me) are somewhat deficient in those skills. They are not used to constructing a narrative, an argumentative narrative of some kind … It does speak to their preparedness. They are not well prepared in this regard."

Appendix H. Data Analysis: Open Coding

Courses 1 and 2: Philosophy of Education

Table H-1. Courses 1 and 2: Results of interviews with instructor and teaching assistants

Categories	Sub-categories	Open Codes	Source
assessments	students were engaged	students participated actively	I1
	some students did not engage	educational inertia	I1
		students preoccupied with other interests	TA1
challenges	can't measure thinking	difficult to assess cognitive skills	I1
	difficult to assess transformative learning	can't measure transformation	I1
	confusion	students' confusion	TA1
	discomfort	pedagogy of discomfort	TA1
		pedagogy of discomfort	I1
	failure to comprehend	students didn't understand the importance of CT	TA1
	lacking preparation for CT	couldn't distinguish ideas from facts	TA1
	some students did not engage	educational inertia	I1
		students preoccupied with other interests	TA1
	student resistance	students' thought professor disorganized	TA1
	takes a long time to learn	long-term process	I1
	wanting the right answer	wanting the answer	TA1
dispositions	acknowledge one's fallibility	lack of ego	TA1
	curiosity	curiosity	TA1
	open-mindedness	open-mindedness	TA1
	scepticism	scepticism	TA1

Categories	Sub-categories	Open Codes	Source
methods	ask questions	ask questions	TA1
		raise questions about issues	I1
	examine alternative perspectives	compare frameworks	TA1
		identify individual needs	I1
	de-emphasize outcomes	allow the experience to happen	TA1
	discussion	conversation and dialogue	TA1
	empathic listening	empathic listening	I1
	establish that there's no single truth	safe space was created	I1
	link material to personal experience	make explanations and processes relevant to people's lives	TA1
	provide guidance	provide guidance	I1
	provide meaningful contexts	make learning process relevant	TA1
	provide structure	give a structure	I1
	remind students to think critically	always needed to remind students to think critically	I1
	safe space	safe classroom space	I1

Categories	Sub-categories	Open Codes	Source
objectives	apply the material	connect ideas with actions	TA1
		make theories concrete	TA1
	avoid prejudgement	avoid prejudgement	TA1
	challenge authority	challenge authority	TA1
	clear questions	clarify the questions that can be answered	I1
	communication skills	communication skills	TA1
	examine alternative perspectives	compare frameworks	TA1
		considering other perspectives	TA1
	create change	create a change	I1
	create meaning	create your own meaning	TA1
	critical thinking	critical thinking	TA1
	distinguish facts from ideas	distinguish ideas from facts	TA1
	evaluation skills	evaluate the information	TA1
	examine identities	examining identity formation	I1
	get a feeling for the material	get them to feel it	TA1
	help others	help each other	I1
	internalize theories	internalize the theories	TA1
	observe accurately	observation	TA1
	question assumptions	question your own ideas	TA1
	question what you're told	don't do just as you're told	TA1
	reflective thinking	reflective thinking	TA1
		self-reflection	I1
	responsible self-expression	make students aware of responsibility for communication	I1
	social awareness	awareness of responsibility for self-expression	TA1
	think for change	think about change	I1
	think new ideas	make them think	I1
	think outside the box	think outside the box	I1

Categories	Sub-categories	Open Codes	Source
outcomes	awareness of new possibilities	acknowledgment of using stereotypes	I1
		some students critical of system	I1
		some students questioned their beliefs	I1
		students changed perspectives	I1
	challenged authority	students challenged authority	I1
	enrolled in following course	some students enrolled in another course with instructor	I1
	exceeded expectations	results exceeded expectations	TA1
	good communication	some students interacted well	I1
	good student performance	produced critical papers	I1
		some students met expectations	I1
		some students wrote "very brave papers"	I1
	independent thinking	some students produced independent thinking	I1
	safe space	trust established	I1
	some students unhappy/dissatisfied	students' anger	TA1
		students' anger	TA1
		students' thought professor disorganized	TA1
	student did extra work	student created scrapbook	TA1
	students encouraged by safe space	safe space was created	I1
	students happy/satisfied	20 percent shared their satisfaction	TA1
		more interest in relevant topics	TA1
		some favourable student evaluations	I1
		some students loved it	TA1
		wanted more classes with instructor	TA1
	students improved their thinking	comprehension	TA1
		self-reflection	I1
	students kept in touch	some students continued to correspond with instructor	I1

Categories	Sub-categories	Open Codes	Source
perspectives	colonialism undermined cultural perspectives	colonialism undermines vast knowledge	I1
	critical thinking is systematic organizing of ideas and strategies	systematic way of organizing ideas	TA1
	critical thinking not a single skill	critical thinking not a single skill	TA1
	critical thinking requires background knowledge	need background knowledge	TA1
	everyone can contribute	some truth is available to each individual	I1
	higher order thinking is exploratory	exploratory thinking	TA1
	important to challenge the students	challenge the students	I1
	important to clarify questions	clarify real questions	I1
	low expectations	transformed thinking not expected	I1
	need to be discomfited	discomfort signals successful teaching	TA1
	need to examine alternative perspectives	need individual approach	I1
		need to treat each student differently	I1
	need to plan carefully	be well prepared	TA1
	need to read a lot	higher order thinking takes practice	TA1
	need to select relevant materials	topics were relevant	TA1
	need willingness	importance of willingness	TA1
	no hierarchies of thinking	no hierarchy of thinking skills	I1
	no one right answer	there never is an answer	TA1
	students need guidance	instructor mediates between students and texts	I1
	teacher-student collaboration necessary	teacher student teamwork	I1
	we can develop intellectual skills	you can develop your intellectual skills	TA1
topics	critical dispositions	topic critical dispositions	TA1
	epistemology	topic -epistemology	TA1
		topic -epistemology	I1
	transformative learning	topic transformative learning	TA1
		topic transformative learning	I1

Table H-2. Courses 1 and 2: Results of interviews with students

Categories	Sub-categories	Open Codes	Source
assessments	assignments were too open-ended	assignments were too open-ended	F
	class discussion very helpful	conversation and dialogue	D
		conversation and dialogue	E
	class discussions not helpful	discussions went off on tangents	F
	superficial work on journal assignments	journal assignments not very effective	F
	the course wasn't about thinking	course wasn't about thinking	E
		course wasn't about thinking	D
	too teacher-centred	lectures sometimes too teacher-centred	F
challenges	assignments were too open-ended	assignments were too open-ended	F
	classroom not best place to learn higher order thinking	higher-order thinking beyond the classroom	B
	difficult material	material was difficult	D
		re-reading for comprehension	F
	difficult to teach thinking skills	difficult to teach higher order thinking	F
	don't know what higher order thinking is	don't know what higher order thinking is	C
	need to realize that we are always biased	need to realize that we are always biased	F
	need time to absorb material	need time to absorb material	B
	higher order thinking takes practice	need practice to learn thinking	B
	never learned about higher order thinking	never learned about higher order thinking	C
	not enough time to read outside material	setting one's own learning priorities	C
	people accept ideas too easily	people accept ideas too easily	F
	people take things at face value	people take things at face value	F
	professors assume too much	professors assume too much	F
	some people are closed-minded	some people simply accept just one reality	E
	unfamiliar material	material was unfamiliar	D

Categories	Sub-categories	Open Codes	Source
dispositions	being organized	to be organized	D
	critically disposed	critical disposition	E
	curiosity	curiosity	A
		curiosity	C
	motivation	fostering motivation	C
		intrinsic motivation	B
	open-mindedness	open-mindedness	B
		open-mindedness	D
		open-mindedness	E
	perseverance	perseverance	B
		perseverance	C
		perseverance	D
	positive attitude	positive thinking	E
	question one's own ideas	challenging your own thought	B
	questioning what you're told	never accept what you're told at face value	E
	questioning what you're told	questioning ideas	F
	resilience	resilience	B

Categories	Sub-categories	Open Codes	Source
methods	analytical thinking	inquire into the source of information	E
	avoid asking too difficult questions	questions not too difficult	D
	clarify distinctions and relationships	create distinctions	D
	collaborating	important to collaborate	E
	critical analysis	elicit critiques	F
		exploring conflicts	A
	dialogue	conversation and dialogue	A
		conversation and dialogue	B
		important to share ideas	F
		need other people's perspectives	B
		conversation and dialogue	E
	encourage critical thinking	some instructors encourage critical thinking	E
	encourage information-seeking	encourage to seek knowledge	C
	evaluate students' cognitive processes	need to evaluate students' thinking	F
	point out exceptions to rule	point to exceptions	D
	present basic information	teach the basics	D
	present controversial ideas	present controversial ideas	F
	present false information	present false information to check reactions	F
	provide guidance	teacher should guide	B
	provide opportunities for higher order thinking	need to furnish opportunities for thinking	F
	re-reading the material	re-reading	D
		re-reading	F
	teach learning strategies	teach effective strategies	F
	use conflict	conflict	A
	use relevant materials	finding an issue of interest	B

Categories	Sub-categories	Open Codes	Source
objectives	analytical thinking	analyze a line of thinking	D
		analyze a line of thinking	E
		analyze a line of thinking	F
		analyze the information	A
	apply the material	decide what to do with the information	A
		linking to experience	C
		pragmatic interest	C
	better comprehension	extend the limits of understanding	D
	broad thinking	broad thinking	D
		broad thinking	E
	challenge authority	challenge authority	E
	comprehension	understand the information	A
	connecting ideas	connecting ideas	B
		connecting ideas	C
	examine alternative perspectives	considering other perspectives	E
	consider fairness and justice	consider fairness and justice	E
	creative thinking	creativity	B
		think outside the box	E
	critical thinking	ability to think critically	A
		ability to think critically	D
		ability to think critically	E
		criticizing	F
		think about something to its fullest extent	E
	deeper thinking	in-depth thinking	C
		in-depth thinking	F
		knowing why and how	A
	develop moral character	critical thinking as part of transformation	E
	evaluation skills	evaluate the information	A
		evaluate the information	D
		evaluate the information	E
		evaluate the information	F
	argumentation skills	look at pros and cons	E
	gain students' confidence	gain students' confidence	B

Categories	Sub-categories	Open Codes	Source
	independent thinking	coming up with own theories	C
		create our own opinions	A
		create your own hypothesis	F
		create your own meaning	E
		creating knowledge independently	C
		don't do just as you're told	E
		need to have your own ideas	F
	metacognition	regulating thinking about thinking	F
	moral character	moral character	E
	new ideas	generate ideas	B
	no bluffing	not trying to bluff	D
	peace and love	peace and love	E
	reflective thinking	reflective thinking	A
		reflective thinking	B
		reflective thinking	D
	communication skills	ability to express oneself	B
	self-organization	to be organized	D
	self-reflection	self-reflection	B
		self-reflection	C
	self-regulated learning	self-regulated learning necessary for higher order thinking	F
	set learning priorities	setting one's own learning priorities	C
	transform society	need to transform society	E
outcomes	acknowledging diversity	acknowledging diversity	D
	becoming more self-aware	awareness of one's biases	C
	being more versatile	versatility	D
	better thinking	became a better thinker	D
	changed perspective	changed perspective	B
	considering other perspectives	considering other perspectives	D
	insight	sudden insight	B
	more reflective thinking	reflective thinking	B
	self-discovery	self-discovery	D
	self-reflection	more self-reflection	C
		more self-reflection	D

Categories	Sub-categories	Open Codes	Source
	setting goals	set goals	D
perspectives	difficult to teach thinking skills	difficult to teach higher order thinking	F
	importance of self-regulated learning	self-regulated learning necessary for higher order thinking	F
	important to suggest strategies	important to suggest strategies	F
	important to teach and learn higher order thinking	important to teach and learn higher order thinking	F
	knowledge is conditional	knowledge is conditional	A
	knowledge is knowing the truth	knowledge is knowing the truth	F
	learning is lifelong	lifelong learning	B
	need conducive physical space	need to provide conducive physical environment	D
	need conducive social space	need to provide stimulating and challenging social environment	D
	need critical thinking	need to think critically	F
	need learning strategies	learning strategies affect outcomes	F
	need peace education	need peace education	E
	need some conflict	conflict	A
	need to behave morally	change behaviour based on moral considerations	E
	need to examine alternative perspectives	always two sides to an issue	E
	need to focus on moral character	need to focus on moral character	E
	need to realize that things are not as they appear	need to realize that things are not as they appear	F
	need to tailor the learning environment	need conducive environment	B
	need to teach and learn thinking skills	more training is needed	B
	need to work with others	need to work with others	F
	some people accept ideas too easily	some people simply accept just one reality	E
	some people are closed-minded	some people simply accept a reality	E
	teachers need to be guides	provide guidance	B
	there's injustice in everything	some sort of injustice in everything	E
	truth is relative	truth is relative	A
		truth is relative	B
	we create knowledge	we create knowledge	A

Categories	Sub-categories	Open Codes	Source
strategies	examine changes in perspective	self-reflection	D
	need to question everything	need to question everything	F
	rereading the material	rereading the material	C
	self-talk	self-talk strategy	F
topics	critical dispositions	topic self-regulation	B
		topic critical dispositions	C
		topic critical dispositions	F
		topic critical dispositions	E
		topic critical dispositions	M
		topic critical dispositions	N
	critical thinking	topic critical thinking	C
		topic critical thinking	F
		topic critical thinking	E
		topic critical thinking	M
		topic critical thinking	N
	epistemology	topic epistemology	F
		topic epistemology	M
	metacognition	topic metacognitive self-regulation	F
	self-regulated learning	topic self-regulated learning	F
		topic self-regulated learning	M
		topic self-regulated learning	N
	transformative learning	topic transformative learning	E

Course 3: Educational Psychology

Table H-3. Course 3: Results of interviews with instructor and teaching assistant

Categories	Sub-categories	Open Codes	Source
activities	examine conflicting data	consider conflicting results	I2
	experimental research project	collected qualitative data	I2
	self-analysis questionnaire	self-analysis	I2
assessments	assignment was useful for self-evaluation	self-evaluation	I2
	low participation level	limited participation in discussion forums	TA2
	need more online discussions	would add more online work	I2
	need more quizzes	would offer more quizzes	I2
	not enough time for deep analysis	online discussions didn't take off	I2
	self-assessment	too passive in moderating discussion	TA2
	students enjoyed the class	students enjoyed process	I2
	students improved their thinking	students improving from the start	I2
	students learned to self-regulate	successful at teaching self-regulation	I2
	students like lectures	students liked lectures	I2
	students were interested	students becoming interested	I2
	students were engaged	actively engaged	I2
	students were overwhelmed	students overwhelmed	I2
	successful strategy	students learned each other's perspectives	I2
	wide variety of outcomes	wide range of results	I2
	students like lectures, multiple choice	students do well with lectures and multiple choice exams	I2

Categories	Sub-categories	Open Codes	Source
challenges	ambiguity in social science	ambiguity in social science	I2
	difficult assignments	difficult assignments	I2
	failure to apply metacognition	metacognition just a concept	TA2
	hard to assess engagement level	difficult to assess engagement	I2
	lacking preparation for CT	many students have little background knowledge	I2
		students poorly prepared	I2
	large class	large class	I2
	need to keep after them	keep on them	I2
	not enough time for deep analysis	not enough time to go into depth	I2
	poor physical layout	poor physical layout	I2
	skipped classes	some students skipped classes	I2
	some students did not engage	some students didn't prepare for class	I2
		some students inattentive	I2
		some students were silent in class	I2
	student resistance	some students very resistant	I2
	students focus on grades	some students interested only in grades	I2
	students used to declarative ideas	students geared to declarative knowledge	I2
	wanting the right answer	believing in truth	I2
		students geared to declarative knowledge	I2
dispositions	open-mindedness	open-mindedness	I2
	positive attitude	positive attitude	TA2

Categories	Sub-categories	Open Codes	Source
methods	ask for definitions	ask students to define critical thinking	I2
	ask questions	ask questions	I2
	avoid lecturing	avoid lecturing	I2
	be available	be available to students	I2
	be responsive	respond quickly to student communications	I2
	competitions	competition	I2
	confirm comprehension of main ideas	confirm comprehension of main ideas	I2
	consider learners' perspectives	consider learners' perspective	I2
	demand explanations	create explanations	I2
	demand justification	ask for justifications	TA2
		justifying ideas	I2
	demonstrations	do demonstrations	I2
	discussion	dialogue	I2
		discussion conversation and dialogue	I2
	emphasize differences in perspectives	emphasize differences in perspectives	I2
	emphasize how rather than what	emphasize how rather than what	I2
	encourage communication	encourage communication between students	I2
	encourage students to go beyond the basics	need to convince students to go beyond	I2
	evaluate newspaper articles	evaluate newspaper articles	I2
	experiments	do experiments	I2
	focus away from factual info	focus away from facts on exam	I2
	focus on cultural differences	focus on cultural understandings	I2
	games	game	I2
	go beyond the limits of declarative knowledge	need to stress limitations of declarative knowledge	I2
	link material to personal experience	linking to experience	I2
	modelling cognitive skills	modelling cognitive skills	TA2
	multi-disciplinary approach	interdisciplinary thinking	I2
	online discussion forum	participation grade	I2
	present controversial ideas	present controversial ideas	I2
	present false information	present false information to check reactions	I2
	present information	presenting information	I2
	problem-based exam questions	exam uses problem-based questions	I2

Categories	Sub-categories	Open Codes	Source
	promote metacognitive processes	promote metacognitive activities	TA2
	provide background info	need to present background knowledge	I2
	provide guidelines for results	give guidelines for planning and self-regulating	I2
	provide multiple ways to learn	give opportunities to learn in different ways	TA2
	provide opportunities for unpredictable outcomes	activities with unpredictable outcomes	I2
	provide practice questions	give practice questions	I2
	provide variety of activities	variety of activities	TA2
	quizzes	good to have quizzes	I2
	reflection	reflective thinking	I2
	relate theories	relate different theories	I2
	search online during class	search online for evidence	I2
	self-evaluation questionnaire	topic metacognitive self-regulation	I2
	small group work	create small groups	I2
	vote on ideas	voting on ideas	I2

Categories	Sub-categories	Open Codes	Source
objectives	active participation	actively engaged	I2
	analysis skills	dissect ideas	I2
		identify central issues	I2
	apply the material	applying one's knowledge	TA2
		need to apply material outside of course	I2
	argumentation skills	defend ideas	I2
	be aware of learning processes	self-monitoring	I2
	change thinking	change their way of thinking	I2
	communication skills	create informative dialogue	TA2
	comprehension	understand fundamental ideas	I2
		understand the information	TA2
	examine alternative perspectives	considering other perspectives	I2
		consider complexity	I2
		consider different contexts	TA2
	consider contradictions	consider conflicting results	I2
	consider implications	have them think about the material	I2
	consider learners' perspectives	consider learners' perspective	I2
	create meaning	create your own meaning	TA2
		generate new knowledge	I2
	critical thinking	critical thinking	TA2
	deep understanding	look for evidence of deep understanding	I2
	deepen the discussions	go beyond the basics	TA2
	evaluation	evaluate ideas	I2
	evaluation skills	evaluate the information	I2
	find facts	find facts	I2
	formulate ideas	formulate ideas	TA2
	identify central issues	focus on assumptions	I2
	inquiry skills	questioning methods	I2
		read up on something	TA2
	integrate information	have them integrate information	I2
	interdisciplinary thinking	interdisciplinary thinking	I2
	justify conclusions	justifying ideas	I2
	metacognitive self-regulation	metacognition	TA2

Categories	Sub-categories	Open Codes	Source
	reading skills	reading skills	TA2
	reflection	reflective thinking	I2
	respond appropriately in context	respond to context	TA2
	self-evaluation	testing one's ideas	I2
	self-monitoring	self-monitoring	TA2
	self-regulation	self-regulated learning	I2
	synthesis	synthesis	TA2
	synthesize information	synthesis	I2
	use examples	use examples	TA2
	writing skills	writing skills	TA2

Categories	Sub-categories	Open Codes	Source
outcomes	deep discussions	deepened the discussion	TA2
	improved thinking	improvement in framing answers to questions	TA2
	inspired others	student inspired others	I2
	learned to moderate discussions	learn how to facilitate discussion	TA2
	motivated beyond getting grades	students learned that grades are not always most important	TA2
	open-mindedness	considering other perspectives	I2
	poor writing	neglect the question	TA2
	questioning content	questioning content of children's shows	I2
	some students coasted	some students coasted	I2
	student became interested in grad school	student became interested in grad school	I2
	student brought material to class	student brought materials to class	I2
	student brought new perspectives	students participated actively	I2
	student inspired others	student inspired others	I2
	student self-realization	student learned value of unstructured approach	I2
	student was happy	student was happy	TA2
	students connected ideas	connecting ideas	I2
	students learned each other's perspectives	successful strategy	I2
	students learned to cite evidence	successful strategy	I2
	students learned to self-regulate	successful at teaching self-regulated learning	I2
	students wanted more testing	students concerned about enough testing	I2
	students were engaged	students questioned the material	I2
	students were satisfied	students liked lectures	I2
	transformed perspectives	student learned value of unstructured approach	I2
	worked hard	student worked hard	TA2

Categories	Sub-categories	Open Codes	Source
perspectives	better to avoid belief in Truth	believing in truth	I2
	better to see knowledge as infinite	seeing knowledge as unlimited	I2
	declarative ideas are closed-ended	declarative knowledge closed-ended	I2
	easier to learn declarative knowledge	students think easier to learn declarative knowledge	I2
	everyone can contribute	value of considering students' perspectives	I2
	importance of a positive attitude	positive attitude	TA2
	important to consider learners' perspectives	value of considering students' perspectives	I2
	memorizing not enough	memorizing not enough	I2
	need more depth	need more depth rather than more discussion	I2
	need more quizzes	would offer more quizzes	I2
	need to apply material	need to apply material outside of course	I2
	need to communicate	need to communicate	I2
	need weekly online discussions	would add more online work	I2
	self-regulated learning very important	self-regulated learning very important	I2
	shouldn't assume students' preparation or interest	shouldn't assume students' preparation or interest	I2
	some students want structure	some students prefer tight structure	I2
	students expect direct approach	students expect a direct approach	I2
	students like multiple choice exams	students like multiple choice exams	I2
	value creativity	creativity	I2
strategies	identify important ideas	identify important ideas	I2
	concept mapping	concept mapping	I2
	keep a learning journal	keep a learning journal	I2
	evaluate and modify ineffective learning strategies	evaluate and modify ineffective learning strategies	I2
	restate the ideas	restate the ideas	I2

Categories	Sub-categories	Open Codes	Source
topics	critical thinking	critical thinking discussed	I2
	learning theories	topic learning theory	I2
	learning strategies	learning strategies	I2
	self-regulated learning	self-regulated learning	I2
		set goals	TA2
	epistemology	talk about knowledge and learning	I2
	theories of metacognition	present models of metacognitive processes	I2

Table H-4. Course 3: Results of interviews with students

Categories	Sub-categories	Open Codes	Source
assessment	no thinking instruction in schools	should have learned about thinking in high school	I
challenges	applying the material in practice	applying the material in practice	H
	can't force higher-order thinking	higher order thinking cannot be forced	H
	can't force learning	learning can not be pushed	H
	can't force transformation	transformation can not be forced	G
	complex thinking comes with age	complex thinking comes with age	H
	difficult to think independently in an academic context	difficult to think independently in an academic context	G
	keeping an open mind	keeping an open mind	G
	overcome biased thinking	overcome biased thinking	J
	overcome cultural biases	overcoming cultural biases	H
	some people are too accepting	some people assume new information is right	G
	teachers don't encourage higher-order thinking	teachers don't encourage higher-order thinking	G
	thinking is a sensitive topic	thinking is a sensitive topic	H
	truth is a confusing subject	truth is a confusing subject	J

Categories	Sub-categories	Open Codes	Source
dispositions	adaptability	adaptability	G
	concentration	self regulation needs concentration	H
	curiosity	curiosity	H
	empathy	empathy applies for thinking	G
	flexibility	flexibility	G
		flexibility	H
		reconsider prior decisions	J
	humility	put ego aside	I
	open-mindedness	open-mindedness	I
		open-mindedness	J
	patience	patience	G
	perseverance	perseverance	G
		perseverance	H
	poise	when learning something important put feelings aside	H
	positive attitude	positive attitude	J
	purposeful	purpose is a driving factor	H
	question one's own ideas	question ones thoughts	G
	questioning what you're told	questioning usefulness of information	H
	relatedness	awareness of relatedness	H
	respect	respect	H
	self-confidence	self confidence	G
	tolerance	be tolerant of failure	G
	self-control	self control	G

Categories	Sub-categories	Open Codes	Source
methods	be as open as possible	be as open as possible	G
	consider students' personalities	consider students' personalities	H
	dialogue	arguing	I
	distinguish relevant information	select necessary information	H
	get help	get help	H
	make it fun	make it fun	H
	modelling	modelling self regulation	G
	offer alternative perspectives	can offer alternatives to how to think	H
		give different sides to story	G
	present justifications	explain why something is wrong	G
	provide graphic organizers	graphic organizers	H
	reinforce students' self-regulative work	acknowledge and reinforce students work at self-regulation	G
	research papers	research one's ideas	I
	stimulate curiosity	triggering curiosity	H
	student presentations	class presentation	I
	use a variety of methods	diversify presentation	H
	use a broad approach	diversify material	H
	use holistic approach	moving from holistic to specific view	H
	use relevant materials	choosing something you are interested in	G

Categories	Sub-categories	Open Codes	Source
objectives	analytical thinking	analysis	G
		analyze the information	J
	apply the material	decide what to do with the information	J
		questioning usability of information	H
	changing perspectives	changing one's way of seeing something	I
	comprehension	understand the information	I
		understand the information	J
		understanding within environmental context	H
	connecting ideas	connecting ideas	I
		connecting ideas	J
	examine alternative perspectives	considering other perspectives	G
		considering other perspectives	J
		don't overgeneralize	J
	critical thinking	critical thinking	G
	evaluation skills	evaluate each situation	J
		higher order thinking requires evaluation	G
	find information	research one's ideas	I
	find proof	need proof	J
	finding answers	reconciling ideas	G
	argumentation skills	good arguments	I
	independent thinking	can develop thinking skills without being told	H
		create our own opinions	I
		don't do just as you're told	I
	metacognition	constant analysis of self regulation	H
		metacognition	I
		self evaluation and reflection very important	G
	objectivity	seeing things objectively	G
	self-awareness	knowing your own temperament	G
	self-development	self development	G
		self scaffold new subject material	H
	self-monitoring	check your understanding	I
		constant analysis of self regulation	H
	sensing	sensory thinking	H

Categories	Sub-categories	Open Codes	Source
	set goals	set goals	G
	synthesis	synthesis	I
	unbiased thinking	unbiased thinking	J
	use self-regulation strategies	different methods for self regulation	H
outcomes	better planning	planning the process	G
	changed perspective	changing one's way of seeing something	I
	intend to study more psychology	want to do more psychology courses	J
	learning to self-regulate	learning to self regulate	G
	setting goals	set goals	G

Categories	Sub-categories	Open Codes	Source
perspectives	cognition is related to emotion	relatedness between cognition and emotion	H
	difficult to define thinking	thinking cannot be boxed	H
	don't need be evaluative	don't believe in conscious evaluation	G
	empathy applies for thinking	empathy applies for thinking	G
	importance of self-regulated learning	self-regulated learning very important	J
	knowing involves light	knowing involves light	H
	knowing involves truth	knowing involves truth	H
	knowing not just about truth	knowing is not exclusively about truth	H
	knowledge changes with time	knowledge is not absolute	G
	knowledge is a passing state	knowledge is a state of being	G
	knowledge is perception	knowledge is perception	G
	language can't completely describe knowledge	language lacks vocabulary to describe knowledge	H
	learning is an activity, not a goal	learning is a process	G
	metacognition is not a constant process	metacognition is not constant	H
	more than one right answer	no one right answer	H
	need appropriate methodologies	methodology determines higher order thinking	H
	need background knowledge	need background knowledge	J
	need evaluation skills	higher order thinking requires evaluation	G
	need internal locus of control	need internal locus of control	G
	need intrinsic motivation	need intrinsic motivation	G
	need social perspective on knowledge	cognition involves a group	H
	need to consider alternative perspectives	different perspectives	G
		different ways to approach problem	H
	need to reflect	knowledge static without self reflection	G
	need to relate to others	awareness of relatedness	H
	need to teach and learn thinking skills	should have learned about thinking in high school	I
	need to use intuition	belief in intuition	G
	no fixed rules for higher order thinking	no fixed rules for higher order thinking	J
	peer group influences learning	transformation is influenced by new peer groups	G
	people want truth	want the truth	I

Categories	Sub-categories	Open Codes	Source
	self regulation depends on context	self regulation depends on context	H
	some people are closed-minded	some people reject new information	G
	thinking is a social phenomenon	cognition is not individual	H
	truth is a confusing subject	truth is a confusing subject	J
	truth is incremental	truth found in increments of different answers	H
	understanding is contextual	understanding is contextual	H
	understanding takes a long time	takes a long time to understand	H
strategies	affective self-regulation	when learning something important put feelings aside	H
	consult others	consult others	J
	create an action plan	questioning oneself on how to achieve goals	G
	evaluate usefulness of material	questioning usefulness of information	H
	generate motivation	tapped into motivation	H
	highlight relevant parts of texts	highlight ideas that suit hypothesis	G
	take breaks from difficult study	take breaks from difficult study	H
	take your time	take your time	H
topics	critical dispositions	topic critical dispositions	H
	critical thinking	topic critical thinking	G
		topic critical thinking	H
		topic critical thinking	J
	epistemology	topic epistemology	J
		topic epistemology	H
	metacognition	metacognition	H
		topic metacognitive self-regulation	G
	self-monitoring	self-monitoring	J
	self-regulated learning	topic self-regulated learning	G
		topic self-regulated learning	H
	transformative learning	transformative learning	J

Course 4: Philosophy of Education

Table H-5. Course 4. Results of interviews with instructor and teaching assistant

Categories	Sub-categories	Open Codes	Source
assessments	debates successful	debates were useful	TA3
	difficult to manage participation	difficult to manage debates	I3
	failed to anticipate students lack of preparedness	did not anticipate that people wouldn't think critically	I3
	frustrated with non-participation	frustrated with non-participation	I3
	good discussions	good discussions	I3
	good lectures	many lectures went well	I3
	good papers	many good papers	I3
	good questions	students asked good questions	I3
	good students	many good students	I3
	good thinking	students thought carefully	I3
	need better materials	material not engaging enough	I3
	need better organization	debates could be better organized	TA3
	not enough analysis	some students didn't do enough analysis	I3
	over-participation	some people participated too much	I3
	room for improving methods	room for improvement in teaching techniques	I3
	satisfactory results	debates turned out well	I3
	some lessons failed	some failures	I3
	some students lacking basic skills	some students lacked basic language skills	I3
	structure promoted critical thinking	class structured for thinking	TA3
	students interested in thinking	students were interested in thinking	TA3
	students struggled	struggling	I3
	students thought independently	students thought independently	TA3
	students were engaged	students engaged with the material	I3
		students engaged with the material	TA3
	students were enthused	students got excited	I3
	successful course	course was successful	TA3
	unprepared for CT	students unused to constructing arguments	I3
	wide variety of outcomes	wide range of results	I3

Categories	Sub-categories	Open Codes	Source
challenges	difficult to manage debates	difficult to manage debates	I3
	difficult to teach self-regulation	topic self-regulated learning	I3
	difficult to think critically	difficult to maintain scepticism	TA3
	discomfort	look at things you don't want to	TA3
	everybody is always biased	everybody is always biased	TA3
		topic bias and neutrality	I3
	failure to analyze enough	some students didn't do enough analysis	I3
	failure to comprehend	not getting it	TA3
		some students could not follow instruction	I3
		Some students failed to grasp objectives	I3
		students didn't understand relevance of material	I3
	failure to think critically	did not anticipate that people wouldn't think critically	I3
	materials are biased	materials are biased	TA3
	materials were difficult for students	some found material difficult	I3
	needed to teach thinking skills	did not anticipate that people wouldn't think critically	I3
	some students did not engage	some students didn't participate in discussions	I3
		some students didn't prepare for class	I3
	student resistance	some thought there was lot of reading	I3
	students lacked interest	had to do back flips to get them interested	I3
	unprepared for CT	students not well prepared	I3
		students unprepared	TA3
dispositions	critical dispositions	foster critical dispositions	I3
	enthusiasm	get the students excited about the subject	I3
	go past discomfort	look at things you don't want to	TA3
	inquiring disposition	disposition to question	I3
	open-mindedness	open-mindedness	I3
		open-mindedness	TA3

Categories	Sub-categories	Open Codes	Source
methods	anticipate difficulties	anticipate learning difficulties	I3
	ask questions	ask questions	TA3
	examine alternative perspectives	compare viewpoints	TA3
	describe higher-order thinking	talked about higher order thinking	I3
	describe metacognitive processes	describe how to check one's arguments	I3
	destabilize prior assumptions	destabilize their assumptions	I3
	discussion	class discussion	I3
		conversation and dialogue	TA3
	essays	reaction papers	I3
	examine arguments	examine arguments carefully	I3
	explain consequences of plagiarism	need to be aggressive in warning about plagiarism	I3
	foster critical faculties	engage in activities that foster critical dispositions	I3
	link material to personal experience	connecting ideas	TA3
	modelling cognitive skills	model non-confrontational dialogue	I3
		need models	TA3
	moderate the discussions	need to moderate class discussions	I3
	provide access to variety of materials	acknowledge biases in materials	TA3
	provide examples and recipes	gave examples of good papers	I3
	provide meaningful contexts	present meaningful context	TA3
	provide reading guides	provided reading guides	I3
		provided reading guides	TA3
	stem the panic	stem their panic through supportive materials	I3
	systematic approach	deliberate and systematic approach to problems	I3
	teach critical thinking implicitly	implicit approach to teaching thinking	I3
	teach learning strategies	talked about skimming	I3
	warn students of difficulties	warn them what they're in for	I3

Categories	Sub-categories	Open Codes	Source
objectives	analysis skills	ability to analyze thoroughly	TA3
	analyze controversial issues	examine contradictions	I3
	apply the material	applying one's knowledge	I3
	argumentation skills	ability to dialogue non-confrontationally	I3
		important to examine arguments fully	TA3
	ask hard questions	get students to ask hard questions	I3
	be aware of biases	make them aware of bias	TA3
	careful thinking	think carefully	I3
	compare viewpoints	contrast viewpoints	I3
	comprehend basics of argumentation	need to understand argumentation	TA3
	comprehension	understand the information	I3
	consider all evidence	important to examine arguments fully	TA3
	examine alternative perspectives	ability to construct arguments	I3
		consider alternatives	TA3
		considering other perspectives	I3
	create and test hypotheses	adopt and test a hypothesis	I3
	critical thinking	learn ct by engaging in it	I3
	draw rational conclusions	draw rational conclusions	TA3
	empowerment	empowerment through learning	TA3
	evaluation skills	evaluating	TA3
	examine arguments	examine arguments carefully	I3
	explanatory skills	explanatory skills	I3
	improve teaching practices	improve teaching practices	I3
	inquiry skills	questioning ideas	TA3
	learn from mistakes	learn from mistakes	I3
	question assumptions	question assumptions	TA3
		question assumptions	I3
	question one's ideas	question ones thoughts	TA3
	reflective thinking	reflective thinking	I3
	seek out differing perspectives	actively look for new ways of seeing	I3
	self-evaluation	self-evaluation	TA3
	stimulate enthusiasm	get the students excited about the subject	I3
	understand relevance of subjectivity	understand relevance of subjectivity	TA3

Categories	Sub-categories	Open Codes	Source
	writing skills	develop writing skills	I3
outcomes	awareness of possibilities	students became aware of alternative possibilities	I3
	changed opinions	students changed their opinions	TA3
	critical analysis	students thought carefully	I3
	enthusiasm	students got excited	I3
	good dialogue	students talked to each other	I3
	good papers	good papers	TA3
	lack of enthusiasm	some students coasted	I3
	positive student evaluations	positive student evaluations	TA3
	students were pleased	positive student evaluations	I3

Categories	Sub-categories	Open Codes	Source
perspectives	better to use implicit approach to teaching CT	implicit approach to teaching thinking	I3
	critical thinking not a single skill	critical thinking not a skill	TA3
	critical thinking needs content	need good grasp on content	TA3
	critical thinking needs context	need context to think critically	TA3
	epistemology not a priority	epistemology not a priority	I3
	good visual images very important	good visual images very important	I3
	important to cultivate critical dispositions	talked about critical dispositions	I3
	important to teach and learn higher order thinking	important to teach and learn higher order thinking	I3
	materials are biased	materials are biased	TA3
	memorizing doesn't help	memory tasks not appropriate	I3
	need a lot of planning	a lot of planning is needed	I3
	need good readings	need good readings	TA3
	need scepticism	difficult to maintain scepticism	TA3
	need to anticipate confusion	anticipate confusion	I3
	need to be more explicit	might add more explicit material on thinking skills	I3
	need to care about topic	relevance of caring about topic	TA3
	need to continually inquire	important to examine arguments fully	TA3
	need to inject new content	need to inject new content to maintain instructor enthusiasm	I3
	need to model cognitive skills	need models	TA3
	need to plan carefully	need to plan carefully	I3
	need to select good materials	choice of texts very important	I3
	need to take time to read carefully	self-regulated learning	I3
	need to understand knowledge	importance of epistemic sophistication	TA3
	need to use a systematic approach	deliberate and systematic approach to problems	I3
	need to write well	develop writing skills	I3
	philosophy requires unique approach	philosophy requires a different approach	I3
	rethinking syllabus	considering changing syllabus	I3
	there are multiple truths	truth based on perspective	TA3
	transformative thinking related to CT	praxis reflection and action	TA3
	truth is consensual	truth is consensual	TA3

Categories	Sub-categories	Open Codes	Source
strategies	read carefully	read carefully	
	skimming	skimming	
topics	alienation	topic alienation	I3
	ancient philosophy	topic ancient philosophy	I3
	bias and neutrality	topic bias and neutrality	I3
	controversies in education	topic controversies in education	I3
	critical dispositions	talked about critical dispositions	I3
		topic critical dispositions	TA3
	critical thinking	talked about critical thinking	TA3
		talked about critical thinking	I3
	emancipative learning	topic emancipative knowledge	I3
	epistemology	epistemology	TA3
	history of education	topic 19th century education	I3
		topic historical philosophy of education	I3
	indoctrination	topic indoctrination	I3
	learning strategies	topic learning strategies	I3
		topic skimming	I3
	metacognition	metacognition	I3
		topic metacognition	TA3
	multiculturalism	topic multiculturalism	I3
	Plato's Ideals	talked about Plato's ideals	I3
	religion	topic religion	I3
	self-regulated learning	topic self-regulated learning	TA3
		topic self-regulated learning	I3
	social constructivism	talked about social construction	I3
	teacher neutrality	topic teacher neutrality	I3
	transformative learning	topic transformative learning	TA3

Table H-6. Course 4: Results of interviews with students

Categories	Sub-categories	Open Codes	Source
assessments	class discussions not helpful	class discussion not helpful	M
	no thinking instruction in schools	no thinking instruction in prior schooling	K
	poor education system	education system not a good one	K
	safe environment	safe classroom space	K
	schools dehumanizing	school system dehumanizing	K
	well-moderated discussions	good discussion orchestration	K
challenges	apply the materials in practice	apply the materials in practice	L
	complex thinking comes with age	complex thinking comes with age	K
	higher order thinking takes practice	higher order thinking takes practice	M
	overcome biased thinking	overcome biased thinking	K
	remembering things	remembering things	K
		remembering things	L
	reward system determines learning	reward system determines learning	M
	comprehension	difficult to understand interactions of complex ideas	M

Categories	Sub-categories	Open Codes	Source
dispositions	attention span	attention span	L
	curiosity	curiosity	K
		curiosity	M
		inquisitive	L
	empathy	empathy	M
	flexibility	flexibility	M
	motivation	desire to learn	N
		intrinsic motivation	M
		passion for learning	K
		passion for learning	L
	open-mindedness	open-mindedness	N
	positive attitude	positive attitude	M
methods	allow for creativity	provide a flexible structure	L
	ask questions	ask questions	K
		ask questions	N
	contrast viewpoints	contrast viewpoints	M
	dialogue	conversation and dialogue	M
		discussion conversation and dialogue	K
		sharing knowledge through group work	N
	encourage self-questioning	encourage self-questioning	N
	examine arguments	look at pros and cons	K
	modelling	modelling	M
	offer alternative perspectives	present alternative frameworks	M
	provide a safe space	safe classroom space	K
	provide feedback	sufficient feedback	M
	provide freedom to think	provide freedom to think	K
	provide good readings	need good readings	K
	provide options	give autonomy	L
	step-by-step teaching	go step by step	N
	writing essays	writing essays	M

Categories	Sub-categories	Open Codes	Source
objectives	abstract thinking	abstract thinking	M
	analytical thinking	analysis	N
		analyze the information	L
	apply the material	applying one's knowledge	M
		applying one's knowledge	N
	changing your perspectives	changing one's way of seeing something	K
	comprehension	clear understanding	M
		extend the limits of understanding	N
		figure things out	L
		understand fundamental ideas	M
		understand the information	K
	connecting ideas	connecting ideas	M
	consider alternatives	consider alternatives	L
		considering other perspectives	K
		considering other perspectives	M
	consider hypothetical situations	consider hypothetical situations	M
	creative thinking	creativity	L
		creativity	M
	critical thinking	ability to think critically	N
		engage critically	K
	deeper thinking	go beyond the basics	L
	distinguish relevant information	dismiss as irrelevant	K
	evaluation skills	evaluate the information	N
	form coherent conclusions	coherent conclusions	K
	independent thinking	create your own meaning	K
		self-starter	L
	inspire motivation	inspire motivation	M
	justification	support your arguments	M
	memorizing	memorizing	N
		memory	K
		memory	K
		memory	L
	new ideas	generate new knowledge	M

Categories	Sub-categories	Open Codes	Source
	problem solving skills	ability to solve problems	L
	rational thinking	think rationally	K
	reflective thinking	reflective thinking	K
		reflective thinking	M
	self-awareness	self-awareness	M
	self-discipline	discipline	L
	self-evaluation	self-evaluation	K
	self-monitoring	examining one's thinking	K
	self-regulated learning	regulate your steps	L
		regulating workload	L
	structured thinking	organize and structure ideas	M
	synthesis	synthesis	N
	understand knowledge	important to understand knowledge	N
	understand people	know other people	K
outcome	deeper thinking	looking deeper and deeper	K

Categories	Sub-categories	Open Codes	Source
perspectives	better knowledge is more philosophical	better knowledge is more philosophical	L
	can't think for someone else	can't think for someone	K
	critical thinking not about truth	critical thinking is not about truth	M
	everything is relative	everything is relative	L
	important to think critically	important to think critically	L
		need to think critically	N
	knowledge is knowing the truth	knowledge is knowing the truth	K
	knowledge is subjective	knowledge is subjective	M
	need background knowledge	need conceptual frameworks	M
	need high expectations	high expectations of oneself	N
	need to base knowledge on experience	use experience and knowledge	N
	need to examine alternative perspectives	individual approach	M
	need to learn step by step	extend the limits of understanding	N
	need to make learning interesting	make learning interesting	N
	need to understand knowing	important to understand knowledge	N
	some knowledge comes from experience	knowledge from experience	L
	some knowledge is "academic"	university knowledge	L
	subject matter should be interesting	subject matter should be interesting	N
	thinking is not a passive process	it is not a passive process	M
	true knowledge is proven	authoritative approval signals truth	N
	truth is relative	truth is relative	M
	understand the value of critical thinking	understand the value of critical thinking	K
strategy	keep notes, records	keep notes, records	K

Categories	Sub-categories	Open Codes	Source
topics	critical dispositions	topic critical dispositions	L
		topic self-regulation	K
		topic self-regulation	M
		topic self-regulation	N
	critical thinking	topic critical thinking	K
		topic critical thinking	L
		topic critical thinking	M
		topic critical thinking	N
	epistemology	topic epistemology	K
		topic epistemology	N
	metacognition	topic metacognitive self-regulation	K
		topic metacognitive self-regulation	M
	self-regulated learning	topic self-regulated learning	N
		topic self-regulated learning	N
		topic self-regulated learning	K
		topic self-regulated learning	M
	topic transformative learning	topic transformative learning	K

Appendix I. Survey Responses to Open-Ended Questions

Table I-1. Views on higher-order thinking expressed by twenty students in Course 2

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
think beyond our metacognition; have the freedom and ability to learn	to connect children to learning we need to connect with them	Positive attitude, non-biased, no stereotyping, no judging, no criticism	there are no right or wrong answers when it concerns our personal past experiences
able to think outside of the box; above and beyond what is expected	*patience, understanding*	*happiness, friendly, resourceful*	*I found it interesting that* the ways of solving complex problems was simplified
things based on importance; I recognize it by covering a significant amount of information	practicalism	open-mindedness, flexibility, feeling	
	creativity	motivation	
looking at a concept using critical thinking and knowledge about various subjects	ability to think critical	patience; and the idea that you don't know everything	that there is no right answer
when someone knows more on a given topic and remembers information better	knowing how children think and listening to them	positive thinking; playing with the children and understanding them	
	creativity	motivation	
thinking beyond one's limit	being open-minded to everything	positive thinking; playing with the children and understanding them	everyone's point of view and sharing ideas is very relevant in adding to one's own idea. We learn from one another
thinking critically and in depth; I recognize it by thinking about what I'm learning	thinking critically and in depth	caring, patience, tolerance	

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
ability to go beyond the surface and think critically	critical thinking - not just taking things as they are; the ability to question	open-mindedness	there is always room for different perspectives. Difficult problems can be solved in different ways.
knowing, being able to apply it and recognizing	metacognition, higher-order thinking	motivation, commitment, positive attitude	
when you understand and then you go above and think critically	reflection, critical understanding	motivation, determination	always think critically and it isn't wrong to disagree
thinking more in depth about the topic	positive thinking	good attitudes, happy and motivated	voice and express opinions
thinking with a structure of ideas	positive thinking	positive attitudes, good motivation, being understandable	We have to voice ourselves, being able to tell what is wrong, express ourselves
put a lot of thought into something		caring, nurturing, patience	I learnt that you have to ask a lot of questions in order to problem solve
the ability to critically analyze what you're learning	critical thinking	positive; care, patience, understanding	different perspectives and understandings can be used for different learners
think beyond the text; the ability to ask questions	critical thinking and learning about yourself	as a teacher I need to be respective of other cultures and other beliefs, even if they are different from my own	It stretches my imagination more, to think outside the box and to listen to other people's opinions. In this course, I was open minded to different philosophies of education, and I was able to take away a little bit of knowledge from each one.
thinking above the common knowledge known of a subject - you recognize it through vocabulary, concepts and ideas	critical thinking skills	open-minded, positive attitude. Caring person, love of children	that everyone seems to have their own personal order of thinking - their own philosophy.

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
being more open-minded to opinions and thoughts	cognitive thinking, rational thinking	positive attitudes, looking forward	the discussions about various topics
higher order thinking is reflected in mature, nonconformist and unbiased reflections into any aspect of life. It is usually developed with a variety of experiences in life.	the ability to transfer/generalize theoretical knowledge to practical life experiences	an open attitude to new knowledge that will likely conflict with your own	that most of life's problems are pretty insignificant

Table I-2. Views on higher-order thinking expressed by nineteen students in Course 3

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
critical thinking	content knowledge would be evaluated thoroughly	motivation	motivation is the source of wanting to learn
think critically; I'd recognize it by having one of those "oh, I get it" moments	being able to put yourself in the child's shoes and analyze from that perspective	A positive attitude. You need to make sure that you have a disposition that makes the child feel comfortable around you so that they know you are there to help them, no to judge and criticize their intelligence	Things are never simple and every situation is different, therefore the knowledge I've acquired needs to be applied in a very flexible manner
Being able to think outside of the box and apply what you learn in class to the world outside of school. You recognize it by knowing that you can apply t and talking to others about the material.	Reflection, because this way you can keep yourself motivated and relate the material to your personal life; this will allow you to recall the information better	You need to have a positive attitude and to be motivated, this is important because you will succeed better than if you don't care.	Higher order thinking will allow you to be creative in your problem solving and help you keep trying if you don't get the answer the first time
Apply newly taught knowledge to existing knowledge, and then combining them and integrating it to everyday situations	critical thinking	motivation and interest in subject; "expert knowledge" transferred to learners	Higher order thinking and solving difficult problems. Strategies need to be taught and scaffolded by teachers
Thinking on a philosophical or psychological level. Analyzing things.	Psychologically understanding the students is important in order to give the student the proper scaffolding	An open-minded attitude; being openly disposed to change, and having a great level of flexibility helps	

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
excelling in thinking or intelligence	hands-on info really helps and background info is ideal	positive attitude ands a general passion or interest in the subject	people lack confidence in solving problems
Learning complex theories, being able to analyze, form an opinion, and./or be able to apply it	critical thinking	One must be flexible, one must be able to assess all factors and apply the best approach	
	patience, respect, being able to deal with children	patience, respect, stay truthful to yourself, think of others' needs first	
	Patience and understanding are key in education, and the skill of adaptation as every group/class/child is different	patience	
Knowing the meaning and how to apply it – not just memorization	organization on presenting and knowing your subject matter	open-mindedness, flexibility	Tracing back my own development where I learned these things (or didn't) and seeing the consequences of having acquired those skills or not.
thinking critically, and taking time to think about a topic	critically	A good positive attitude	Solving problems is interesting because there is a final outcome and you must work hard by thinking about the topic
	organization, adaptability, making links, breaking things down	ability to think on your feet, sense of humour, mental flexibility	be able to back up your b-s
the ability to take as topic and build upon it. I recognize it by realizing how one topic can be the basis of another.	critical thinking, and the ability to apply information to situations	willingness to learn, openness to knowing new things and realizing you might be wrong	There are infinite ways of solving problems and each of them can be right, Therefore there are infinite ways to learn as well.
Elevating one's intellectual capacities so that one may contribute fully to the	the abilities to reflect, innovate and empathize	kindness, curiosity and selflessness	The inter-connectedness of ideas and discourses are

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
intellectual social discourse			like a domino effect – once it starts, it goes, and so many new avenues of exploration are open to you
able to think objectively about different situations, topics	logical/objective thinking	positive attitude, perseverance/determination	I found that I have difficulty solving complex problems. That is, my "higher-order thinking" capacities are medium to low.
thinking outside the box; looking at problems from a different perspective	self-regulated learning, because you teach people to plan, monitor and evaluate their own learning	Intrinsic motivation is the most important attitude. If people don't know why they are doing something, they won't do it.	the concept of self-helplessness, that some students do not believe in themselves
		self-regulation, motivation to study	
		Positive, relaxed attitudes	

Table I-3. Views on higher-order thinking expressed by twenty-eight students in Course 4

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
abstract thinking	critical thinking	avoid politics and put the children first	
	critical thinking	open mind	
synonymous with critical thinking. Involves mastery of basic facts (tools) and then using them to discuss/generate changes in knowledge	ability to think critically	ability to reason, to consider the opposite point of view in order to either validate or discredit your own	
when someone is able to criticize without judging a particular subject	ability to use deductive reasoning, and inductive reasoning	being assertive in a constructive manner, learning how to take initiative for one's own learning processes	many perspectives to think about; knowing what's a fact and what's more subjective
looking behind the author's main idea; recognize it by wanting to achieve a	critical thinking and understanding	to learn the self, to understand and discover	knowledge is surprising, sometimes you don't really

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
higher understanding			know how much you know
analyze, organize and develop different points of view or different ideas about complex subjects	good package of information, diversity of opinions, language organization/communication	open to diversity, understand other points of view and opinions. Discussion, analysis and understanding	learning about complex subjects is a challenge to me. I've been facing diverse situations around the world and I *think that analysis* and understanding are very important to be able to solve problems or to try to solve them
reflecting on complex issues	critical thought	openness to new ideas	I found I was able to read through and understand complex readings, and look at certain situations in a new light
thinking on a level that is more than just general knowledge	patience, cooperative learning, creativity	friendly, optimistic, love of learning	the challenge of solving something that's difficult
levels of thinking, analyze abstract ideas	critical thinking	How I view things makes a difference in my learning; most important thing is attitude	challenges me, and I am capable of higher-order thinking
ability to think about thinking	ability to think critically	openness to change and differences	
thinking critically - taking it one step further			
to think critically about a subject, first to learn and understand, then to criticize	understanding, comprehension and critical thinking	there is never one answer, but many positions which need to all be covered	
It means thinking/reflecting deeper. It's about reflecting on materials in order to form an opinion.	critical thinking skills	self-discipline, self-motivation, curiosity	I found that I enjoyed learning about complex subjects. I find that the most interesting subjects are philosophical questions, psychological essays.
critical thinking. Questioning everything	critical thinking	patience	it's more inspiring than learning by rote

Meaning of Higher-Order Thinking	**Skills**	**Attitudes**	**Most important things learned**
the ability to think critically about a topic and examine it from all points of view	critical thinking, thinking on your feet	personable, outgoing, friendly	that it is really not as difficult as I thought it was to understand; just read it slowly, digest it and think about it.
To look beyond the lines. You must take what the author wrote and critically analyze what he means	critically thinking; you must make sure you don't believe everything that you read	good sense of humour, open to change, creative, sincerity	when you put your mind to it you can do whatever you want; solving difficult problems means you think critically
resembles Bloom's taxonomy; to be able to know who, what where and when are the general knowledge skills, etc. I recognize higher order thinking among those who teach about specific things and are interested	to criticize and examine, curiosity is the sign of intelligence	positivity; motivation; encouragement, support physical and mental wellness	learning about complex subjects . When you are really able to dig your nails into something you thought was impossible is extremely self-fulfilling
mathematical thinking or problem solving	critical	self-confidence, organizational skills, people skills	if you back up your argument, your argument will be considered
seeing above the ordinary, or maybe critical multiculturalism where you evaluate every though	empathy - being able to get into your students' minds - associating your lesson with their pre-existing maps.	familiarity and professionalism	Just in this course we examined a sort of linear understanding of *philosophies of education* and had the opportunity to experience these firsthand and see how others did it.
	Critical thinking and making judgments	positivity	
thinking critically; it involves analyzing and making a judgment		teachers and students have to have a positive attitude	higher order thinking is important for looking at the pros and cons and coming to a conclusion
cannot identify higher order thinking unless you know the subject of the	to say what others don't think of	persistent	analyzing

Meaning of Higher-Order Thinking	Skills	Attitudes	Most important things learned
thinking			
engaging critically with an idea to the extent that the thought has some impact on a person's views; ultimately this is self-regulated and recognized	see previous; a constant critical analysis of oneself and one's actions. Also, though qualitative, it is of utmost importance to have positive thinking skills, that is, the ability to find good and have fun	loving children; loving life; believing that life is beautiful and children ought to learn (not to become cogs in the machine of society but because they'll be happier because of the knowledge.	the profound effect it has on my concept of self and my belief systems. It triggers evaluation and re-evaluation
thinking outside the box and using things I've learned and applying them in my everyday life	critical thinking, analytical, being open to new ideas	being open to others' ideas, responsive to their thoughts and feelings, being positive and non-judgmental	I like challenges, and some of the readings for this class were definitely challenging; it was great that others as well as the teacher got me thinking about some things I had never thought of before
to have the strength and the ability to really think outside the box; I recognize it when I have to think critically on my own	critical thinking	to learn through self-discovery	
critical and well reflected thinking that has potential arguments	adaptation, responsible, reasonable, polite	optimistic, positive, fairly demanding, acknowledgeable	that it is very contradictive
beyond the common, everyday stuff; deeper stuff	critical thinking; looking at things from more than one point of view	openness to differences, lack of judgment	exposure to topics and subjects beyond my usual consideration
being able to think critically about philosophy, recognize it only in myself when I feel like a light bulb going off in my head	tolerance, acceptance, empathy and critical thinking	asking questions, willingness to learn, being open-minded	that I'm a lot better at it now than a few years ago! Solving problems is never easy, but if you trust in the process, the outcome will be valuable (good or bad).