Screen-free learning for success in the digital age:

A case study of developmentally appropriate technology use at the Toronto Waldorf School

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Abstract

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Adolescence is a crucial time for the enhancement of 21st century competencies such as new media literacies, critical thinking, problem solving, creativity, and self-regulation. If digital interventions in education are broadly assumed to support the development of these competencies, critical research describing the challenges they pose and how best to mitigate them is needed. Developmentally appropriate technology use literature emphasizes strategies for young children in educational settings, however, the same attention has not been levied to pre-adolescents and adolescents – despite the frequency of their engagement with digital devices and their continued developmental needs. While previous research has posited Waldorf education may represent a developmentally appropriate path to new media literacy education, no studies of Waldorf schools have attended this inquiry. The purpose of this study is two-fold: 1) to describe the perspectives and practices of families and teachers at the Toronto Waldorf School with respect to technology use for pre-adolescents and adolescents; and 2) to understand the effects of a delayed technology integration in contemporary educational contexts.

Keywords: developmentally appropriate technology use, technology in the classroom, Waldorf education, adolescents

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Chapter 1: Introduction

> Learning from a computer is not education; the machine does not care. Learning from a person behaving like a machine is not education; that person's capacity for care is being suppressed. It is care that is the basis of creativity in teaching, at all levels from Kindergarten to PhD supervision, as the teacher's practice evolves in response to the learner's development and needs. (Connell, 2013, p. 104)

As the province of Ontario continues to increase its use of digital technologies, hybrid learning, and e-learning programs in K-12 education – despite persistent challenges which the COVID-19 pandemic has only brought into sharper relief – educators and policy makers must be attentive to strategies that can support the unmet needs of students and teachers. Answering Hoechsmann and Poyntz's (2008) call to look to alternative sectors for innovation in public education, this study will revisit the principles and practices of developmentally appropriate technology use in search of strategies for success in 21st century classrooms through an instrumental case study of the technology-deferred instructional experience at the Toronto Waldorf School.

Given the proliferation of technology and digital devices throughout the modern world of work, and the power of information and communications technologies (ICT) to enhance teaching and learning, many schools have adopted digital technologies in the classroom. While the specific tools, applications, and use-cases abound, it is important to define what is meant by technology in the classroom. A unified definition of 'technology' in education remains elusive (Warner et al., 2018), though it is often understood as that which helps us to work, learn and play (Alper, 2013), and can take the form of artifacts, knowledge, activities, or values (Rushby et al., 2016). In this work, technology is understood as that which mediates human activity. This can

take the form of a computer, a hammer and nail, or even the act of reading. In the education context, ICT is linked to the shift from computing power used as a force for data storage and manipulation, to the mechanism for complex communication and information retrieval (Hogenbirk, 2020). In simple terms, 'ICT' is some combination of the Internet or information service (such as a Learning Management System), and the device with which we access it, such as interactive whiteboards, computers, projectors, televisions, etc. 'Digital device' refers to tools such as tablets, cellphones, Chromebooks, etc., that support access, and is frequently used to delineate one-to-one use-cases in which students engage directly with the devices themselves – in contrast to watching a teacher use an interactive whiteboard. Despite the transformative power of these technologies in the classroom, not all schools have jumped on the bandwagon.

Research Context

Over the last few years, articles highlighting the "screen-free" educational experience provided by Waldorf schools have been published in *The New York Times* ("A Silicon Valley School That Doesn't Compute"), *CNBC* ("Inside the tech-free school where high-tech parents are sending their kids"), *The Guardian* ("Tablets out, imagination in: the schools that shun technology"), *Business Insider* ("Silicon Valley parents are raising their kids tech-free — and it should be a red flag"), and recycled as clickbait by many other news agencies. Part of the reason for their popularity is the implied paradox: why are the Silicon Valley technocrats building the screens sending their kids to screen-free schools? Reading these articles, we are left with a clear picture of what Waldorf schools are *not* but not a very deep understanding of what they are and *why* that is. Waldorf pedagogy remains understudied – especially the ways in which these schools do use digital devices and multimedia. They offer a unique point of study in the pursuit of developmentally appropriate technology use because they carefully consider a child's

developmental stages with respect to curriculum and tool use, arguing both act as mediating tools on the child's developing skillset, awareness of themselves, and perception of the world around them.

What is Waldorf?

Emerging from Rudolf Steiner's pedagogical philosophy and the work of practitioners across the world over the last century, Waldorf schools take a holistic approach to education, focused on teaching the "head, heart, and hands" (Barnes, 1991), and supporting the physical, social, emotional, cognitive, and spiritual needs of students (Nordlund, 2013). Instruction ranges from fine arts such as music, art, and drama, technical arts such as pottery, metalwork, and horticulture, and academic subjects such as math, physics, chemistry, and language arts. In this way, students experience a balanced curriculum in every school day. Learning activities are interdisciplinary and multisensory (Nordlund, 2013), engaging multiple intelligences in a non-competitive, group-oriented approach that cultivates a sense of wonder, curiosity, and connection. Teaching practices emphasize critical thinking, an ethical orientation towards global issues, and relationships with other people and the environment, with the end goal of producing free, moral, and balanced individuals (Nordlund, 2013; Oberman, 2008).

To do this, Waldorf schools use a curriculum which supports students through their distinct developmental stages. Waldorf schools regard the development from child to adult as *the* foundational principle of education (Ullrich, 2008; Uhrmacher, 1995; Hughes, 1992; Aeppli, 1986), and this conviction has a significant impact on subject offerings, teaching styles, and technology use. Unlike other pedagogical approaches (which focus more exclusively on the developmental stages of young children) Waldorf schools also attend to the healthy development stages of pre-adolescents and adolescents. Underscoring this approach is the belief that youths

must move through each stage of development as naturally and richly as possible – otherwise, they may be limited as an adult (Uhrmacher, 1995; Aeppli, 1986). While knowledge transfer is important, the curriculum and learning are understood as a vehicle for healthy development: in this way, the primary focus of the Waldorf educational experiences is to educate the child "so that feeling, thinking, and doing would all combine to develop a healthy person" (Wardle, 2009). In support of this goal, conventional academic timelines and scheduling practices, assessment measures, teaching strategies, and tools for teaching are often rejected, and preference is given to social engagement, physical activity, and outdoor play (Dahlin, 2017; Ullrich, 2014).

Although Waldorf schools around the world have sought to integrate and embrace 21st century technology in different ways (Stehlik, 2019), choosing to delay technology is not new to Waldorf pedagogy. Since its inception in the 1920s, schools have delayed the teaching of reading, citing developmental health of learners (Stehlik, 2019; Uhrmacher, 1995; Aeppli, 1986). Typically, teachers do not formally teach reading until elementary school, with some waiting as late as Grade 3, though they engage in pre-literacy activities from kindergarten onwards. Nevertheless, with respect to the Ontario provincial government's early reading strategy benchmarks (Expert Panel on Early Reading in Ontario, 2003), this would mark many Waldorf students as developmentally delayed or 'at-risk' readers. Globally, however, studies have found that Waldorf students show no deficits in literacy development and some out-perform their public-school counterparts a short time after learning to read (Larrison et al., 2012; Ullrich, 2014). Other findings suggest higher levels of creativity (Huchingson & Huchingson, 1993), and find evidence that Waldorf graduates outperform other schools with respect to self-actualization, moral reasoning, social engagement, and attitudes such as tolerance, empathy, and responsibility towards the environment and other people (Dahlin, 2017; Graber, 2012). As a result, Waldorf

education has been suggested by some scholars as a site for studying how to better prepare students to be creative thinkers (Huchingson & Huchingson, 1993; Woods & Woods, 2009), in addition to highlighting the schools' approach to global and digital citizenship-oriented teaching practices (Code, 2020; Graber, 2012).

Technology Abstinence or Technology Deferred?

There is no formal policy within Waldorf pedagogy with respect to educational technologies. It is up to each teacher to determine how, when, and why to engage with new teaching and learning tools. Generally speaking, however, Waldorf pedagogists[1] and practitioners highlight the following themes for safe use of educational technologies:

- Information technology is inappropriate for use in Lower School classrooms, however, intentional use in high school classrooms is encouraged (Mitchell, 2002).
- High school students should develop skills in computer literacy and they should understand the principles of information systems, programming, and hardware and software design (Avinson & Rawson, 2014).[2]
- Teachers should emphasize the development of human senses, such as creativity, critical thinking, and resilience in students (Maynard, 2018). ICT use is especially appropriate when it engenders creativity and excitement for learning and students

[1] 'Pedagogist' is used to refer to subject matter experts in Waldorf education who write articles and reports on best practices that are intended to be read by teachers, parents, and other members of the Waldorf community. These can be found in publications such as *Renewal*, the *Research Institute for Waldorf Education*, and the peer-reviewed journal *Research on Steiner Education.*

[2] A comprehensive list of recommendations is summarized in Avinson and Rawson's (2014) *The Tasks and Content of Waldorf Education*.

need media literacy and information literacy to be able to navigate the world freely and effectively (Avinson & Rawson, 2014; Glöckler, M, 2018).

- Many pedagogists cite Steiner's call to prepare students for the world of tomorrow (Glöckler, 2018), and that means supporting their engagement with the modern world. Students should use digital technology when they are able to design and build elements of it themselves, and to understand how socio-cultural and historical trends have shaped the design and use of these tools (Mitchell, 2002).

While this approach to 21st century skills has been misrepresented as a "technology abstinence movement" (Clemons, 2015), it may be more appropriate to title it a technology *deferred* approach. Steiner never called for a ban on the use of technology, but suggested that as exposure increases, so to increases the need to strengthen "those human capacities that technological devices mimic or threaten to supplant" and to consider "at which age will children have developed these skills sufficiently so that these 'tools' can serve rather than subvert them" (Gerwin, 2018, p. 8). As such, it is more accurate to say that Waldorf schools intentionally delay the use of educational technologies, for both teaching and for learning, until children reach specific stages of development (Glöckler, 2018), just as they delay some academic expectations. Critics suggest students are missing out on valuable technology-mediated learning experiences without considering the challenges that undercut those learning outcomes. They wonder if technology is treated as "an item of abhorrence rather than a beneficial tool" (Clemons, 2015) but fail to engage with practioners' attitudes. They point to the "lost time" for developing digital skills, without examining whether skill development in adolescents has been impacted, or what is actually lost in the school time allocated to teaching digital skills in primary school.

Despite the ever-increasing need for 21st century skills, Waldorf education is one of the fastest growing independent school systems (Oppenheimer, 2004; Harrington, 1993), with over 1,000 Waldorf schools worldwide and over 150 schools in North America ("Waldorf World List," 2022). For many, the choice of Waldorf education is – and has long been – one made in reaction to perceived missteps of public education curriculum and society at large (Stehlik, 2019). Families continue to be drawn to the promise of a developmentally oriented holistic educational practice, knowing full well it means their children are not able to use technology as early as other students. Studying the perspectives and practices with respect to technology use in this context can help to map the multifaceted outcomes of developmentally oriented pedagogy, especially its impact on physical and socio-emotional development. Correspondingly, it may also provide insight into new strategies for moral and ethical development to support digital citizenship in today's youth, and a potent site for interrogating the significance of early digital literacy teaching and skill acquisition for later performance.

(For a more detailed description of the principles of Waldorf education, especially pre-adolescent and adolescent development, please see the literature review.)

The Toronto Waldorf School

This case study examines perspectives and practices at the Toronto Waldorf School (TWS), an independent school in the Greater Toronto Area. On average, the school maintains around 400 students, and offers programming from Pre-K to Grade 12. Notably, it is the only Waldorf school in the province that offers a provincially accredited high school program. As a result, the high school is subject to inspection from the Ontario Ministry of Education every two years. As an independent school in Ontario, however, it does not receive federal or provincial funding (Asadolahi, et al., 2022). Tuition costs range from $ 20,410 to $ 22,620 annually, and

the school maintains a registered charity organization (The Toronto Waldorf School Foundation) to offset tuition costs for families.

Previous Coverage of this School

While this site has never before been the subject of scholarly inquiry, it was featured in a 2005 *MacLean's* cover story article entitled, "How computers make our kids stupid". At that time, the school offered computer-mediated learning in High School only, maintaining: "We're not Luddites or anti-computer. But we are for introducing important technologies at the right time in the development of children" (Ferguson, 2005).

Waldorf in the Canadian Context

TWS is one of 11 Waldorf schools in Ontario, one of 25 in Canada, and one of about 150 in North America ("Waldorf World List", 2022). It is part of a larger network of Waldorf schools in the country, united under the Association of Waldorf Schools in North America (AWSNA). This group puts out their own publications (such as *Renewal*, a journal for Waldorf Education), and hosts conferences across North America. They also provide accreditation for Waldorf schools, a process which was initiated by the Toronto Waldorf School in 1991. This research pays special attention to the Toronto Waldorf School's "social curriculum" and how it supports mental health for adolescents by emphasizing socio-emotional health and wellness.

Situating the Research Problem

Findings from the Ontario Student Health and Drug Use Survey (CAMH, 2021) paint a troubling portrait of the mental health of students today. Between seventh and 12th grade, 38% of students rate their mental health[3] as "fair" or "poor" and half (47%) of students indicate a

[3] Mental health is defined as one's emotional and psychological well-being (CDC, 2021)

moderate to-serious level of psychological distress (symptoms of anxiety and depression).[4] One-in-five rate their physical health as "fair" or "poor" and over half are not getting at least eight hours of sleep. One-in-six secondary school students report symptoms of moderate-to serious problematic technology use.

The Math Doesn't Add Up

Although "screen-time" is an imperfect measure of engagement,[5] it is still the measure used by pediatrics to determine healthy and safe screen use in this country, and the current calculus does not stack up. Over half of secondary school students spend at least five hours a day on electronic devices (CAMH, 2021), the percentage of students reporting digital device time of seven hours a day or more has increased from 12% in 2019 to 26% in 2021, and these calculations do not include mandatory exposure for school or homework. Yet, the Canadian Pediatrics Society and the Canadian Society for Exercise Physiology recommend school-aged adolescents spend less than two hours a day engaging with screen-based technologies.

Meeting The Needs of A 21st Century Education in Ontario

Students in the 21st century need school support to develop digital literacy, digital citizenship, and resiliency capacities to face threats incurred in their interactions with Web 3.0 (Poyntz et al., 2020), such as algorithmically fueled disinformation and radicalism (Wylie, 2019), and attention economy-driven distraction and digital device addiction (Alter, 2017; Rosen, 2017). They also need skills and competencies to meet the requirements of the

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[4] In this report, psychological distress is measured by the Kessler Psychological Distress Scale, which scores for symptoms of anxiety and/or depression experienced during the past four weeks (p. 3).

[5] Screen time as a general metric misses the subtleties of passive and active uses, or creative versus consumption-based engagement. Researchers advocate for a consideration of what, how, and why questions with respect to media use ((Daugherty et al., 2014).

contemporary workplace, which prioritizes creativity, complex problem solving, and critical thinking (The Partnership for 21st Century Learning, 2019; Binkley et al., 2012).

Adolescence is a crucial time for the development of these higher order thinking processes and social cognition (Goldfus & Karny-Tagger, 2017; Mills, 2016; Marin & Halpern, 2011; Sowell et al., 1999), with refinements to working memory and attentional control allowing for more sophisticated and speedy causal reasoning and problem solving (Bauer & Burch, 2001). As young people transition from family to peer-oriented relationships (Giedd, 2012; Roeser et al., 2000), they learn prosocial behaviours such as empathy and collaboration through interpersonal interactions, and develop self-regulation and resiliency. Environmental experiences during this period dictate neural development through myelination, and as a result, educational experiences in middle and high school are directly implicated in the growth of these crucial 21st century capabilities (Goldfus & Karny-Tagger, 2017; Roeser et al., 2000).

Yet, if socio-emotional learning and higher order thinking skills are the bedrock of 21st century competencies, teachers struggle to find the time to support their development given the emphasis on standardization, marketization, individualized learning, and academic skill development (Zhao & Gearin, 2016). The move towards mandatory e-learning in Ontario only underscores this trend, as do the shifts towards technology-mediated interactions in K-12 education, and budget cuts to education (Pressprogress, 2021) that impact arts funding and extra-curricular activities (Bolden, 2022; Farrington & Shewfelt, 2020; Fancourt & Finn, 2019; People For Education, 2021). Despite the benefits of digital device use for sustaining schools and social interaction during school closures, it is clear that digitally-mediated engagement cannot replace face to face interactions in support of these socio-emotional outcomes in schools (Watkins, 2020).

Information, Communication, and Technology (ICT) interventions are increasingly understood as educational "silver bullets" by politicians, capable of generating 21st century learners by virtue of their presence (Moore et al., 2021; Rosen, 2020). Adoption in the classroom is often driven by "utopian perspectives" that are not linked to evidence-based practice or the specific needs of learners in context (Dlamini & Nkambule, 2020). There is little consideration for the persistent challenges they pose to self-regulation, empathy, and isolation (Turkle, 2012), nor is there meaningful consideration of the short- and long-term effects of exposure and addiction, given how much time these students are already spending engaged in digitally mediated environments at home (Alter, 2017; Gladwell, 2021). Moreover, despite paying lip service to digital citizenship, there is no provincial policy or curriculum for digital citizenship , and as a result, limited assistance for social learning outcomes which support the foundational capacities of empathy, morality, and civic engagement (Turkle, 2015) . Given the impact of disinformation, radicalism, and cyberbullying present online, we are still in need of a "whole school approach" to emotional intelligence (Humphrey et al., 2007) and to "being digitally active within an overall ethical and behavioral context" – a kind of "character education" for the 21st century (Ohler, 2010).

ICT should be integrated with respect to the developmental health of students – and with a clear understanding of what they *can't* get through a screen. As educators across the province continue to bring technology into the classroom with varying degrees of funding, delivery, and success, and without access to robust training (Ivus et al., 2020), it is time to revisit the pillars of developmentally appropriate technology use and reconsider its implications for adolescence, not just early childhood. At a critical stress-point in this province, we need to look outside of the

public school system to find alternative strategies that may help with healthy socio-emotional learning and higher order thinking skills.

Exploring An Alternative Approach To 21st Century Education

Exemplifying a low-tech, developmentally oriented approach to ICT and digital literacy education in Ontario, the Toronto Waldorf School presents a unique site for investigating the challenges outlined, especially with respect to the mental health and socio-emotional needs post-pandemic. Despite the availability of digital learning tools, parents, and teachers at TWS intentionally limit screen time and digital device use – both at school and at home – in their efforts to support what they believe to be the competencies students need for success in the 21st century, such as problem-solving, creativity, digital citizenship, new media literacies, emotional intelligence, and more. While no research has examined perspectives and practices in technology integration within this pedagogy, Waldorf education has been suggested as a "smarter path" to 21st century education (Oppenheimer, 2004), given the pedagogy's ethical orientation and its 'offline' opportunities for the development of 21st century skills such as creativity, computational thinking, and media literacies (Ahmadi et al., 2019; Graber, 2012; Tsortanidou et al., 2022).

Waldorf education attends to intellectual, creative, and moral development, recognizing that what a child experiences impacts them functionally and structurally (Hughes, 1992). As a result, stimulation is carefully controlled in the learning environment. Although Waldorf students do not regularly use media, screens, or digital devices until high school, they practice the skills needed for digital participation offline to prepare them for use when it is appropriate (Graber, 2012). Practitioners believe that if a child is given a tool too early in life, it supplants the skill that it was intended to supplement – that tools can become crutches (Gerwin, 2018). Simply put,

the teachers and parents work to limit students' exposure to digital technologies, favouring "the right thing at the right time".

While a wholesale adoption of Steiner pedagogy is likely incompatible with the public system, lessons learned can certainly be applied (Nordlund, 2013; Woods & Woods, 2009; Oberman, 2008; Uhrmacher, 1999). For example, Oppenheimer's (2004) analysis demonstrates how elements of the Waldorf approach have been used to bolster public education in California, especially with respect to socio-emotional and behavioural challenges. Woods and Woods' (2009) case study in the UK makes explicit recommendations for translating Waldorf practice into the public sector to improve creativity in the classroom. Graber (2012) hopes Waldorf practices may one day find their way into public schools, offering students a chance to "experience a developmental approach to new media literacy that will equip them to be creative, capable, and ethical" with technologies "that are yet seeds in their imaginations" (p. 90) As such, this research pays special attention to the ways that the Toronto Waldorf School supports pre-adolescents and adolescents as they build 21st century competencies in communication and collaboration, creativity and problem-solving, empathy, self-regulation, and resilience, in developmentally appropriate ways.

Purpose Statement

In an effort to understand the complex intersection of forms of knowledge, pedagogical practices, and attitudes that continue to mobilize a community of developmentally oriented practice towards delayed technology integration, the purpose of this study is two-fold: 1) to describe the perspectives and practices of families and teachers at the Toronto Waldorf School with respect to pre-adolescents and adolescents, and technology use; and 2) to understand the

educational and developmental effects of delayed technology integration for pre-adolescents and adolescents in contemporary educational contexts.

Research Questions

The following research questions guide this project:

1) What does a community oriented towards developmentally appropriate technology use look like?
2) How do the different drivers of teachers, parents, students, pedagogists, and the Ontario Ministry of Education interact to affect technology for teaching and learning at the school?
3) How are decisions about 'appropriate' technology use made?
4) What objectives are met by delaying technology use?
5) How does a 'developmentally oriented instructional experience' build 21st competencies and develop digital literacies in students?
6) How has this school approached recent periods of compulsory online learning?

Brief Overview of Methodology

This study uses an instrumental case study approach (Stake, 1995) to describe a developmentally oriented approach to technology use in K-12 education, combining observations of classes and facilities, document analysis of curriculum and policy, and semi-structured interviews with key stakeholders within the community. The findings are understood through the lens of Third Generation Cultural Historical Activity Theory (CHAT), selected for its emphasis on complex and socially situated human cognition with respect to technology in learning contexts (DeVane & Squire, 2012).

Significance of the Study

Results from this study will offer insight into whether students can build the skills necessary for success in a digital world without inappropriate exposure to technology. This research highlights the antecedents to creative and complex problem solving. It also emphasizes the building blocks of digital citizenship. Findings from this study will add evidence to discussions about limiting children's access to technology. If the principles of early literacy development have been exported to the digital literacy context (Relkin et al., 2020; Parette et al., 2010), this site provides a unique window into what happens when ICT supports are limited and delayed in the classroom, and how that impacts later digital literacy development. Findings can support educational practice for educators and schools marginalized by inequitable resource access in the Canadian digital divide. They can also provide insight to teachers in any pedagogical system interested in developmentally appropriate technology use and schoolboards in Canada tasked with developing robust policies that benefit all Canadian students.

Chapter 2: Literature Review

This literature review provides the background information needed to understand the problem, case, results, and discussion. First, it engages with general literature about the kinds of skills and competencies which are considered essential for students to find success in the 21st century. It also explores how systemic incentives and practices impact their development. This is done in an effort to provide context for the problem/need for the research. It starts with a broad analysis that draws on international findings, then narrows to highlight recent Canadian K-12 ICT policy and integration efforts for learning with tools and learning how to use them. Given the study object's location, this section summarizes challenges present in Ontario schools in 2022. Next, the literature review examines the field of developmentally appropriate technology use, exploring its links to developmentally appropriate practice, and significant findings in the interactions between digital device use and youth. Significant literature within the field of developmentally appropriate technology use is summarized so as to highlight the gaps that remain – especially with respect to the development of adolescents, the mechanisms for judging "appropriateness", and the potential effects of cognitive tools. This is done to provide a framework for understanding potential solutions that emerge in the findings for the research problem. The aims and practices of Waldorf education are explored, with emphasis on the developmental approach that motivates the teaching practice, curriculum, and engagement with technology. This is done to help prepare the reader to better understand the study object and findings. The literature review concludes with an explanation of Third Generation Cultural Historical Activity Theory and Stake's case study recommendations.

21st Century Skills and Competencies

In 2018, the Director for Education and Skills at the OECD acknowledged:

> We live in a world in which the kinds of things that are easy to teach and test have also become easy to digitize and automate. When we could still assume that what we learn in school will last for a lifetime, teaching content knowledge and routine cognitive skills was rightly at the centre of education. Today, the world no longer rewards us just for what we know – Google knows everything – but for what we can do with what we know. (as cited in Watkins, 2020)

How should schools respond? 100 years ago, public education existed in large part to prime factory workers for attendance, attention to detail, and discipline; now, much of that manual labour and routine skill can be accomplished by machines (Zhao & Gearin, 2016; Binkley et al., 2012; Brynjolfsson & McAfee, 2014). Excellence in the modern world means interdisciplinary connections and flexible thinking, fluency with complex problem solving and the literacies needed to support it.

What Does School Need to Prepare Students For?

In their *Assessment and Teaching of 21st Century Skills*, the authors' highlight the need to "communicate, share, and use information to solve complex problems", "adapt and innovate in response to new demands and changing circumstances", and "use technology to create new knowledge" (Binkley et al., 2012). This emphasis on competencies such as communication, critical thinking, and problem solving is echoed in various 21st century skill frameworks (ICTC, 2021; ISTE Standards, 2017; Carlgren, 2013; Berger & Starbird, 2012; Alliance for Excellent Education, 2011; Johanson, 2010; Sahlberg, 2006), and while the inventories are many, their findings are typically similar. For example, *The Partnership for 21st Century Learning*, which surveyed education, business, and policy experts, recommended "Creativity and Innovation; Critical Thinking and Problem Solving; Communication; and Collaboration", as part of their

Frameworks for 21st Century Learning (which also includes "Life and Career Skills" and "Information, Media, and Technology Skills" (The Partnership for 21st Century Learning, 2019).

Broadly, these frameworks identify 21st century skills within four categories: *ways of thinking, ways of working, tools for working*, and *living in the world* (Binkley et al., 2012); given the number of frameworks and the various names for overlapping concepts, let's take a minute to clarify the terms used in this document. I find this umbrella term approach helpful for understanding and comparing other frameworks of competencies. For example, in the ISTE Standards (2017), a "Creative Communicator" must demonstrate the ability to "communicate clearly" (*ways of working*), and "express themselves creatively" (*ways of thinking*), "using the platforms, tools, styles, formats and digital media appropriate to their goals" (*tools for working*).[6] I've tried to align with the frameworks referenced in Canadian policy documents and as such, I employ a distinction between *competency* and *skill*. Competencies are understood as one's ability to effectively meet a need, and this response is often made up of skills, attitudes, and knowledge (Future Skills Centre, 2016). For example, effective collaboration could require a combination of emotional intelligence, language ability, and mastery of ICT applications.

Preparing Students for The Modern World Of Work.

In order to meet the demands of a modern workplace, Binkely et al. (2012) argue that "schools must be transformed", so that students can "acquire the sophisticated thinking, flexible problem solving, and collaboration and communication skills they will need to be successful in

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[6] While splitting these up into categories makes it easier to talk about each one, they are not always so easily delineated. Certainly one needs to be able to *use* the internet effectively to *gather* the information needed to begin to *think through* the problem-solving process. This 'separate but same' overlap between thinking and doing sits at the heart of digital literacies and digital skills. It's helpful to split them up – especially for evaluation – but any situated example typically involves an interweaving

work and life". Implicit in these calls to action is the belief that students need to be equipped with competencies for successful employment, and calling for 'a transformation' suggests something is currently amiss.

The Right Hand Doesn't Know What the Left Hand Is Doing.

In the very early days of TED talks, it felt like everyone watched Sir Ken Robinson's (2006) talk on schools and creativity – more specifically, that they were *killing* it. Actual practices stifle creative and divergent thinking in students as educators are dis-incentivized from taking time to support them (Slomp et al., 2014; Zhao & Gearin, 2016). How does this happen?

Defined as "using imagination to generate new ideas" (Zeitz & Sakai-Miller, 2016), creativity is effectively a method of problem-solving. Despite positive framing within education discourse (Sawyer 2015), anti-creativity biases abound in schools (Henriksen et al., 2018; Yahn & Kaufman, 2016). This is important because people are not born creative – it is a habit formed over time and one which can be influenced (Kirkham and Kidd, 2017). As they learn and grow, they develop the belief and willingness to engage with creativity (Sternberg, 2016), and school plays a role in supporting the development of a creative mindset (Choi, 2020; Henriksen et al., 2018) when it provides opportunities to be creative, and encouragement and rewards when creativity is pursued (Zhao & Gearin, 2016). Unfortunately, the "messy reality" of creativity can be threatening for teachers trying to stick to a schedule (Ahmadi et al., 2019; Yahn & Kaufman, 2016). Teachers often understand creativity with respect to the arts but do not consider its role in knowledge creation and problem-solving (Ahmadi et al., 2019; Diakidoy & Phtiaka, 2002). Moreover, creativity is often neglected in assessments (Ahmadi et al., 2019; Binkley et al., 2012). Despite everyone agreeing it is important, it is not valued in students' experience.

If public education may be purposefully engineered to deter creative thinking and meaningful critiques of homogenized power structures (Chomsky, 1988, 2000), there's a much less contentious observation to be made here: the incentive structures of neoliberal public education are not yet oriented towards 21st century skill building blocks such as creativity, critical thinking, collaboration, and problem-solving. If creativity is "fetishized as the key to unlocking growth" (Kauper & Jones, 2019), it is the neoliberal management of classroom practice that is killing it.

Systemic Dis-Incentives.

Contemporary public education in the West can be categorized as an era of standardization and marketization (Code, 2020; Sahlberg, 2006). Standardization is linked to the methods of evaluation, in which external benchmarks are brought to bear on schools by centralized decision-making systems (Zhao & Gearin, 2016). Marketization is linked to the neoliberal turn, which understands all aspects of existence as economic (Giroux, 2005). Because of this, 'success' in education is assessed much like market performance, in terms of "productivity, efficiency, and profitability" (Farhadi, 2019, p. 41). Many reforms are oriented towards teaching more, at a faster pace (Aeppli, 1986). By way of explicative contrast, a "slow curriculum" contests speed, efficiency, and markets in favour of holistic alternatives that encourage creativity and well-being (Kauper & Jacobs, 2019).

While standardized assessments are intended to improve educational outcomes, certain outcomes are more readily testable, and overall improvements do not necessarily follow in the wake of standardization (Slomp et al., 2014). Emphasis on external testing results in a loss of professional autonomy for educators and undermines their discretion in how best to serve students. This presents in many ways, but in the context of 21st century skills, it can mean taking

time away from teaching the higher order thinking skills they believe to be important (Alberta Teachers' Association, 2017; Kauper & Jones, 2019; Sahlberg, 2006; Zhao & Gearin, 2016) and teaching testable content at the expense of regular instruction (Carlgren, 2013; Hobson & Vu, 2015; Nichols & Berliner, 2007; Slomp et al., 2014) – even when the 'testable content' measures "shallow, convergent analytical thinking in the context of problems that largely do not matter" (Sternberg, 2016, p. 260). In essence, while the goal of standardized assessments may be to improve performance, in practice, these measures directly threaten the aims of a 21st century education.

It's no wonder many students have come to understand their role in the classroom as efficient test taker (Carlgren, 2013) or that teachers observe that students seek the quickest route to the right answer and prefer to avoid risk and uncertainty (Kauper & Jacobs, 2019). As this high-stakes testing is increasingly enmeshed with learning analytics, students continue this performative approach to learning, in an effort to "please the indicators" (Selwyn, 2019). Despite an individual teacher's desire to work with problem-solving skills, or an individual student's wish to engage more critically with the material they are learning, these responses are ultimately deterred by the system which seeks to measure traditional literacies and convergent thinking (Zhao & Gearin, 2016; Slomp et al., 2014), and attention to them takes place more in name than in practice. As it stands, by taking time and reward away from these activities, we are educating *away* from higher order thinking competencies identified by 21st century frameworks, leading students further from the core competencies of problem solving, rather than towards them.

Serving Three Incompatible Masters.

The tension between convergent and divergent thinking, between learning *as a good* and learning to *get a grade*, between school time that is intended to develop marketable skills or school time devoted to the development of a rich inner life is not new. In *The Educated Mind: How Cognitive Tools Shape Our Understanding* (2007), Canadian author Kieran Egan outlines the arc of "crises" in Western education: calls for transformation ring out and blame shifts from student to teacher to parent to administrator to policy maker to politician to society and back again like a game of hot potato. Underneath these crises in education, he suggests, there lies a much older problem: the goal of education is divided against itself.

First, school is intended to develop citizens who will fit into society. That means instilling certain values, but it also means ensuring they have up-to-date skills for market participation. Second, much of the Western tradition inherited the Platonic approach to learning: that knowledge and the pursuit of Truth are valuable in and of themselves, and that school should develop sophisticated thinkers who can critique the foundational assumptions on which society runs. Third, that school is a site of development for the learner as they grow as individuals. Subject matter is a means to an end, not an end in and of itself, and curriculum a vehicle for learning how to learn. While superficially these may seem like they can co-exist, Egan's (2007) analysis reveals the incompatibility of each with the others. Understanding this incongruity clarifies the difficulty of meaningfully teaching 21st century competencies: stakeholders within the educational eco-system have slightly different orientations towards each of these three goals. As a result, time that could be devoted to socio-emotional development is allocated towards time to develop marketable skills, or activities to promote digital citizenship are pulled in favor of pure academics.

Whom Do Schools Serve Today?

If Binkley et al. (2012) argue transformation will help students be successful in "work and life", it is important to recognize that calls for 21st century 'reform' are motivated by external ideas of economic competitiveness (Poyntz & Pedri, 2018; Alliance for Excellent Education, 2011; Saavedra & Opfer, 2012) and these changes are rarely related to – let alone determined by – what teachers and students actually need in the classroom (Moore et al., 2021; Sahlberg, 2006). As a result, there is a bitter sense for teachers that what must to be taught is determined from on high; that the individual teacher's professional capacity to respond to their students is devalued, and that the students' response to that curriculum is irrelevant. This suggests that the public school of the 21st century serves neither the students, nor the teachers. If producing literate citizens is not done for the good of the citizen, but to produce a subject who can be used by the labour market (Poyntz et al., 2020), then public education in the neoliberal context is a fundamentally "employee-oriented education" (Zhao & Gearin 2016). In short, the answer to "what does school need to prepare students for?" is always predicated on determining whom the school serves.

This is foundational for determining appropriate use of technology in education: the judgment of its 'appropriateness' as a means to an end is always predicated on that end. Where to draw the line depends on where we are standing: Is school for the market-based society – delivering a fresh batch of workers to increase its productivity? Is school for Truth – pursuing knowledge as a good for its own sake? Or is school for the individual – supporting them as they learn and grow into free beings in the world? It cannot be all three.

Defining 21st Century Competencies.

Excellence with *tools for working* speaks to one's ability to access, manage, and evaluate information, analyze media and apply technology effectively, often summarized as "ICT and Information Literacy" or "Digital Literacy" (Brinkely et al., 2012). Information literacy overlaps with concepts of media literacy, which in turn depends on good old "literacy-literacy". As Jenkins (2009) suggests, new media literacies build on the foundation of traditional literacy, research skills, technical skills, and critical-analysis skills, and function in many ways as social skills. In this way, the modern tools for working are dependent upon *ways of thinking* and *ways of working*, as much as they are linked to one's operational fluency with digital tools.

Unfortunately, much of the ICT education in schools over the last 20 years has focused on teaching technology and neglected these foundational skills (Graber, 2012). ICT education ages out quickly and assuming we can support students from birth into jobs that will exist for them 20 years in the future by educating them to a series of standardized benchmarks is "a highly dubious proposition considering how quickly technology and the economy changes" (Zhao & Gearin, 2016, p. 131). Notably, this is slowly changing, and some schools are taking advantage of more innovative approaches to using ICT for learning. The ISTE Standards' changing focus highlights this shift from teaching tools to teaching with tools: In 1998, it was "Learning to use technology" – teaching students how to use these tools effectively; by 2007, it was "Using technology to learn" – focusing more on creativity and cognitive skills; and the most recent edition in 2016 emphasizes "Transformative Learning with Technology" – focusing on learning, not technology, wherein the technology is a means to an end, not a goal in and of itself. Some educators at specific schools have implemented more unique use cases for ICT in the classroom, such as 3D printing initiatives (ICTC, 2021; Klingbeil, 2016), but there is no evidence of

provincial standards in training, infrastructure, and funding to support equal opportunity of experience for students. The negotiation between teaching foundational literacies and teaching specific technology skillsets continues. Determining just how specific to get when it comes to employability skillsets is a difficult balancing act, but "educators cannot merely provide students with skills that work in today's society […] Many skills used today will be useless quite soon. One of the few things that will help students in the unforeseeable future is creative skill" (Runco, 2016, p. 66).

Ways of thinking is understood as the confluence of creativity and innovation, critical thinking, problem solving, and decision making, learning to learn and metacognition (Brinkley et al., 2012). While most of these are clear, the term critical thinking is difficult to pin down: in essence, it is a form of judgement that is both "purposeful" and "self-regulatory", allowing for "interpretation, analysis, evaluation, and inference" (Abrami et al., 2015). Because *we* are implicated in the process of critical thinking, it includes a metacognitive component; the thinker must be able to reflect on the parts of themself that have led to their judgement (Abrami et al., 2015). To perform it, learners need a firm grasp on knowledge – rather than mere access to information – and a strong understanding of self and bias.

Given the proliferation of solutions available via a quick "Ask Siri", what problem-solving is left? Complex, context-dependent issues for which no precise solution yet exists. In order to solve these kinds of problems, one must be able to connect ideas which are not so obviously linked as to be detectable by an internet search; this requires creativity and flexibility in thinking, the ability to transfer thinking skills between context ("Critical Thinking," 2018). Solving these kinds of complex problems requires collaboration with others, and sophisticated thinking, but strong problem-solvers also depend on self-efficacy and trait resilience (Li et al.,

2013). The solver needs to contend with disappointment as they trailblaze a new path into the unknown, to be able to try again – and again and again. There is a significant emotional component to this task (Hannula, 2015), one which can be overlooked in the classroom.

In a sense, complex problem-solving is dependent on one's enthusiasm for difficult innovation. Here, another overlooked component is key: curiosity. Curiosity is defined as "a desire to know, to see, or to experience something that motivates exploratory behavior directed towards the acquisition of new information" (Litman, 2005). Children seek out the unknown with relish – in sharp contrast to many adults who shy away from the uncertainty they experience in the face of problems with no clear solution. With this in mind, we might deepen our definition of curiosity: a pleasurable orientation towards problem-solving. 'Coaching to curiosity' is an increasingly common buzzword in IT and business for this reason. Tasks are increasingly automated and the work of human employees is left to solve problems, yet those employees are uncomfortable in that process, and more reticent to strike out into the unknown than they were as children. If we are to truly support complex problem solving, schools must make time for curiosity and creativity, allowing for alternative forms of assessments which reduce the anxiety of failure and allow students to develop competencies in context-dependent project work (Abrami et al., 2015; Carlgren, 2013). Despite directly nourishing curiosity, creativity and situated problem solving, problem-based learning and discovery learning are often impossible because there "isn't enough time". Because that time isn't taken, many schools continue to produce students who are conditioned to pass tests, to fear failure, and to be uncomfortable with uncertainty.

Ways of working involve communication skills and collaboration with others (Brinkley et al., 2012). This certainly calls upon literacy – one's ability to functionally read, write, and

understand others – but also multimodal literacies (Lenters, 2018; Peterson & McClay, 2012) and inter-cultural competencies (Arghode et al., 2022). Notably, both communication and collaboration rely on emotional intelligence and interpersonal expertise (Magro and Pierce, 2016) – the absence of which many of us have keenly felt with challenging co-workers. Even in a remote work context, skills in emotional intelligence such as communication, self-direction, trustworthiness, discipline, initiative, flexibility, and self-efficacy remain in high demand (Tyagarajan, 2019). Perhaps the single greatest building block of the emotional intelligence pyramid is empathy; given the inability of AI/automation to replicate empathy, this most human skill is integral in an increasingly AI-dominated market (ICTC, 2021; Tyagarajan, 2019). It's also critical for design-thinking (Zeitz & Sakai-Miller, 2016), and essential if we are to work and live *well* together. Unfortunately, the amount of time young people spend engaged with devices and not with each other may have a negative impact on the development of that empathy (Turkle, 2015).

Living in the world includes an awareness of citizenship, both local and global, the ability to manage one's life and career, and meaningful personal and social responsibility built on cultural awareness and competence (Brinkley et al., 2012). Much of this is built on a foundation of emotional intelligence. One's ability to manage personal adaptability, impulsiveness, self-esteem, self-motivation, and stress management, social competence and empathy, and emotional regulation in order to adapt to contexts such as the school, workplace, or home (Humphrey et al., 2007) is a predictor for success in life (Goleman, 2006) Given their basis in face-to-face interactions, these abilities are tricky to build in digitally mediated environments.

Living in the world *well* increasingly calls up one's ability to interact with the digital world in a healthy manner. Encounters with addiction, distraction, radicalization, and more are

posing increasingly complex challenges to many peoples' lives (Alter, 2017; Fox, 2018; Rosen, 2017). If many of the current frameworks for digital literacy were designed to help people *participate* in the world online (Jenkins, 2009), the power of Web 3.0 pulls us in with greater efficiency and subtlety than ever before. Infinite scrolling dominates major platforms such as YouTube, TikTok and Instagram, and it is used in concert with other behavioural design features to keep people engaged (Alter, 2017; Fox, 2018). In short, there are limited barriers to participation in this brave new world – and extreme barriers to disengaging. As a result, critical skills for successfully living in the world center around one's ability to control and limit device use in order to secure basic sleep hygiene, physical exercise, in addition to screen-free activities and an offline social life. While this may seem like a low bar, keep the statistics of use in mind. Competencies to support disengaging may be just as critical as competencies to support participation.

Meeting These Competencies in The Classroom.

Given the adaptability of creativity and emotional intelligence, 21st century competencies can be developed with the help of classroom practices. Students benefit from collaborative dialogues and "thinking together" with teachers, and co-constructing meaningful learning experiences (Manalo, 2020). Researchers recommend complementary relationships between teachers and students where feedback and dialogue are encouraged (Piirto, 2016; Abrami et al., 2015) and teachers are sensitive to moments where core learning goals are better met by changing up the lesson plan in response to student interest or need (Piirto, 2016). Time should be allocated to authentic and situated problems and project-based assessments which demand creative, problem-solving skills (Abrami et al., 2015; Zhao & Gearin, 2016) as these give students the opportunity to engage with a creative mindset and develop solutions (Zeitz & Sakai-

Miller, 2016) and allow students to focus more on why than on the 'right answer' (Piirto, 2016). Arts should not be treated as extra (Piirto, 2016) and emphasis must shift away from high-stakes testing tied to job expectations for teachers (Zhao & Gearin, 2016). Students benefit from safe, supportive, and engaging (Zhao & Gearin, 2016) environments that de-emphasize failure (Piirto, 2016).

In Summary.

The aims and practices of 21st century education are out of sync. Despite calls for schools to produce creative problem-solvers capable of strong communication, collaboration, and emotional intelligence, systemic incentives continue to educate away from these goals. While individual teachers and specific classroom practices can work to develop these 21st century competencies, schools need to adopt a unified ethos and orientation towards them if they are to truly be "transformed".

Responding To the Demands of a 21st Century Education: The Canadian Context

In an effort to supply students with exposure to the operational capabilities and cerebral capabilities they need for success, many Canadian schools have turned to technology-enhanced instruction for support. A 2020 report issued by Canada's *Information and Communications Technology Council (ICTC),* noted it "amplifies student learning by providing interactions that can shape their future educational journey and encourage new ways of thinking. By developing these foundational concepts from an early age, technology in the classroom is key to equipping students for success in a rapidly expanding digital economy" (Ivus, et al., 2020).

I highlight this first, not because it is controversial, but because it feels representative of the attitudes and rhetoric of educational stakeholders in this country (Gallagher & Rowsell, 2017). First, there is the sense that education supported by technology is transformative, that it

can *amplify* learning, and that this change applies not only to learning activities but also to *thinking*. Second, that integration should take place sooner, rather than later. Finally, that the measure of *success* in life is defined by market competitiveness. It offers insight into the patterns of rhetoric that have been employed to bring technology and e-learning into Canadian schools, despite the challenges posed to educators, parents, students, and public education.

Undoubtedly, there is significant demand for talent in the digital economy (Ivus, et al., 2020). In order to meet that demand, young Canadians need "Fundamental Employability Skills" such as using ICT to share information and choosing appropriate tools for project work ("Employability Skills," n.d), and these *tools for working* must be supported by competencies such as problem-solving (*ways of thinking*), and communication (*ways of working*). Correspondingly, this section charts out the ways in which Canadian schools have taken up the challenge of transforming themselves to meet these 21st century demands.

But writing about Canadian ICT use in education presents two distinct challenges. First, much has changed – and quickly! Broadly speaking, the use of digital technology in Canadian classrooms has shifted in step with the rise of mobile device adoption and ubiquitous internet connection. As a result, much of the good work of peer-reviewed authors is already wildly out of date. The paradigm shift in online learning over the last two years only compounds this problem. Second, actual practice in the country is fragmented, given the lack of federal and provincial ICT standards in educational policy (Brookfield Institute, 2017; Howell and & O'Donnell, 2017; ICTC, 2021; McLean & Rowsell, 2019). Despite calls to develop "pan-Canadian" ICT education standards to bolster infrastructure policy, none have emerged (Gallagher & Rowsell, 2017). This has led to uneven delivery across the country, with quality often divided along socio-economic

lines. As a result of the speed of change and fragmentation present, trying to paint an accurate picture of "Canadian ICT education" is a difficult task indeed.

Technology Integration in Canadian Schools.

Information and Communication Technologies (ICT) offer a myriad of possible applications as tools for learning, and this technology integration in the classroom can take many forms. At the simplest level, it is used to replace the previous mechanism of information delivery: the whiteboard and paper. Teachers might use a Promethean board to play a PowerPoint presentation, and students might take notes on their laptop or use their personal cellphone for instructional activities. This aligns with the more traditional orientation of learning, in which the teacher delivers education to the student. At the most complex level, interactions between teacher and student are mediated through devices, allowing them to collaborate and create together as equals (ICTC, 2021, p. 44-6) in a fashion that parallels the turn towards socio-constructivist learning theories that now dominate Faculties of Education in Canadian teacher training (DeWaard, 2022).

What Specific Technologies Are Teachers Currently Using in Canadian Classrooms?

In addition to information display tools, most students encounter some form of one-to-one device use in the classroom. That device might be a cell phone or Chromebook or an iPad depending on what province they are in, and it might be one supplied by the school or brought in as part of a Bring Your Own Device program (BYOD) (Ivus, et al., 2020). To contextualize this further, in Ontario, about 40% of middle schools, and 66% of secondary schools encourage BYOD every day (Kapoor, 2019). Best practices highlight the need for teachers to "purposively, meaningfully, and naturally embed technology" in learning activities, and to weave children's

digital literacy practices into the "fabric of their everyday learning" [7] (McLean & Rowsell, 2019, p. 177). Simply bringing devices into the classroom is not a silver bullet. The benefits of these tools are profoundly tied to the instructional strategies they are used to support, and they rely on infrastructure to support them. Correspondingly, both benefits and challenges have been observed by educational stakeholders as we further integrate digital devices into Canadian classrooms.

Benefits And Challenges of Technology Integration.

Studies note improvements to engagement (ICTC, 2021; Ivus, et al., 2020; Nie, 2019), especially through gamification (ICTC, 2021), and cognitive effect, as students are encouraged to develop capacities in abstract thinking, planning, and problem solving with ICT support in their learning (ICTC, 2021). Students gain access to external resources, such as digital content to enrich their lessons and immersive AR or VR environments to explore new experiences (ICTC, 2021; Karsenti & Bugmann, 2017), and students in remote areas can gain access to the same resources as urban students (ICTC, 2021). Students with learning or physical disabilities can be accommodated by technological adaptations to their needs, and learning can take place at their own pace – even from the comfort of their own home (ICTC, 2021; Karsenti, 2015*).* Students and teachers can communicate outside of the classroom through learning management systems (Nie, 2019) and students can work together on projects after school without meeting up in person (ICTC, 2021). Students can take control of their learning goals with technology facilitated self-assessments (ICTC, 2021) and technology can help teachers develop new forms of assessment.

[7] Notably, each of the tools referenced are done so in accordance with a particular brand name. There is this sense that the embedding of ICT into the "fabric of everyday learning" is also the braiding together of private corporations and public education, which we will return to shortly.

Teachers can explore alternative teaching methods, such as flipped or hybrid classrooms, and these are considered "student-centric" as they transform students into active participants in their learning, rather than passive receivers (ICTC, 2021). Notably, these outcomes are not guaranteed, and may engender a series of challenges; as one study noted, using tablets for in-class learning was "a necessary risk" given the advantages of the tools (Ivus, et al., 2020).

Disadvantages, such as student distraction, can negatively impact learning outcomes, as teachers end up focusing on behavioural management instead of teaching (Ivus, et al., 2020; Nie, 2019; Vahedi et al., 2021). There are also challenges with BYOD programs in which software or infrastructure issues relegate teachers to troubleshooting instead of teaching, and socio-economic differences leave students disadvantaged (Ivus, et al., 2020; Nie, 2019). Notably, 30% of Canadian families do not have reliable internet for their children to be able to use their devices at home to complete homework or e-learning/blended learning components and 70% have not bought a new computer for their home in the last five years (Future Skills Centre, 2021). Many teachers have acknowledged their lack of training and knowledge undermines the efficacy of the benefits (Connelly, 2015; ICTC, 2021) as they are not confident about using the tools available; some may only use the tools they learned in teacher's college which fall out of date quickly (ICTC, 2021), and technology vendors often don't provide sufficient training on how to use them[8] (Connelly, 2015; Ivus, et al., 2020). Some schools cannot afford dedicated or onsite IT services, or they may not be available for every grade level (Ivus, et al., 2020), and technical challenges persist (Connelly, 2015; Sinay, 2018). Budgets pose significant challenges to keeping

[8] In a particularly farcical moment, one report highlights e-learning programs available for teachers to stay up to date on ICT tools, while noting that they are already working an average of 50 hours a week (Ivus, et al., 2020).

technology and software up to date, and as a result, outdated technologies are often present in the classroom (ICTC, 2021). This issue of cost is compounded by differences in socio-economic status (SES), as many schools supplement their budgets with fundraising, and higher SES districts are able to afford more robust and up-to-date tools as a result, leading to inequitable access to tools across the country (ICTC, 2021; Watkins, 2020). Teachers have noted that the aims of policy makers or administrators are not aligned with the needs of educators and students, and that conflict between systems in schools leave teachers unsupported as they try and make use of ICT (Connelly, 2015; Sinay, 2018; ICTC, 2021). Privacy and data collection issues persist, given the partnerships between schools and private companies which stand to profit from the data they gain about user and learning analytics (Ivus, et al., 2020; Tranjan et al., 2022), and this is particularly significant when parents cannot actually opt out of this ICT integration while keeping them in public school (Moore, et al., 2021). Teachers question the level of commercialization present in this integration (Nie, 2019), and whether ICT use is really about improving learning outcomes or about training brand loyalty and creating "customers for life" (Ivus, et al., 2020; Moore, et al., 2021).

With these benefits and challenges in mind, is technology-mediated learning living up to the utopian vision the *ICTC* report suggests? If schools are having a hard time keeping up to date with the technology, software, and teacher training needed, how effectively are they training students for the technical skills needed to maintain a competitive edge in the market? If it's difficult for students to self-regulate around technology distraction, how useful is "early exposure" and how necessary is it for later success? One also wonders, if schools are struggling to support the cost of these tools, where is money being diverted from?

Measuring The Effect of ICT On Learning in Canadian Schools.

Although limited within the Canadian context, global studies of the effect of ICT interventions in classroom abound. Depending on the argument one seeks to advance, there is evidence of improvement (Cameron, 2015; Cheung & Slavin, 2012; Shamir-Inbal & Blau, 2016) and evidence of the "no significant difference phenomenon" [OECD, 2015; Oppenheimer, 2004; Russell, 1999; Spitzer, 2014). As a result, conclusions from rigorous meta-analyses are critical for answering this question. Without diving into the minutiae of these debates, it is clear that when used alongside clear objectives, meaningful activities, and pedagogically sound practice, ICT use has resulted in low-to-moderate effects for students (Calderón-Garrido et al., 2022; Borokhovski, et al., 2020). Unfortunately, the realities observed in many Canadian schools directly undermine the 'soundness' of practice. For example, if inadequate teacher training and support plays a significant role in the impact of technology on student achievement (Borokhovski, et al., 2020; Graafland, 2018; Graber, 2012; Jenson, et al., 2007), inadequate teacher training has been observed in virtually every study and survey in the Canadian context (Connelly, 2015; Ivus et al., 2020; Karsenti, 2016). Moreover, since some teachers admittedly lack the confidence and expertise with digital pedagogy to deliver high quality instructional experiences tailored to children's needs (ICTC, 2021), they may rely instead on passive media, "drill and skill" software, and other inappropriate strategies that can actually stifle emerging capacities in students (Cameron, 2015; Karsenti, 2016; NAEYC/Fred Rogers, 2012; Rosen & Jaruszewicz, 2009). Does technology amplify learning for Canadian students, as the *ICTC* report suggests? The answer: sort of … sometimes. Questions at this scale are difficult to answer with any certainty. There are many benefits, and the realization of those benefits continues to be threatened by many unresolved challenges.

In light of this uncertainty, it is encouraging to remember that most of the benefits of use outlined above are possible without the use of ICT in the first place: Lessons can be interactive, engaging, and otherwise student centric and active; gamified, up to date, and accommodating of learning diversities … these benefits are not linked to any *essential* character of digital technologies in the classroom. Even skills which seem directly linked to digital devices, such as computational thinking, can be taught in unplugged classrooms (Tsortanidou et al., 2022). Nevertheless, money for ICT-mediated learning continues to pour forth, with many Canadian classrooms standing as "graveyards to costly gadgets imposed on educators to answer problems they did not name" (Moore et al., 2021). Why?

Edtech and the Silver Bullet.

'Quick fixes' carry with them a certain allure – a way to solve problems without really doing the work. In this way, digital tools are often persuasive or *charismatic* in their own right, irrespective of the realities of their use. As Ames (2019) articulates, "a *charismatic technology* derives its power experientially and symbolically through the possibility or promise of action: what is important is not what the object is but how it invokes the imagination through what it promises to do" (p. 9). The promise of educational technologies, such as One Laptop Per Child program, are representative of this charisma, but it exists across the EdTech field, and has for a long time: "We are frequently excited by the promise of a revolution in education […] We have the technology today, and tomorrow we confidently expect to see the widespread effects of its implementation. Yet, curiously, tomorrow never comes" (Rushby et al., 2016). Techno-solutionism, the belief that the (ever-elusive) *correct* application of technology can solve our problems, is increasingly implicated in political discourse on education (Rosen, 2020; Selwyn, 2019).

In the Canadian context, educators continue to sound the alarm that charismatic technologies are being marketed to politicians and administrators as a way to transform schools to "solve" public education – especially in the face of funding cuts (Moore et al., 2021). These tools can aid with learning, but they can also function as inroads, ways to shoehorn the private EdTech industry into public education, especially when it comes to online learning. Offering a "cost-effective" way to modernize learning – despite the many challenges e-learning continues to pose in the K-12 context – the push towards e-learning underscores the marketization of public education: that value should be placed over values (Moore et al., 2021). While this discussion is ultimately beyond the scope of this inquiry, neoliberalism in Canadian public education sits at the heart of technology integration into the classroom. As such, I am compelled to return to it when seeking answers to questions of "why".

In Summary.

Despite the transformative potential of digital tools in the classroom, this potential has not delivered on the promises of improved learning for many Canadian students, and these tools continue to pull critically low funding away from other initiatives. Fragmentation across the country with respect to policy and curriculum limits the consistent acquisition of tools, training, and delivery (Chen, 2015; Hoechsmann & DeWaard, 2015), which continues to result in unequal opportunities for students (Howell and O'Donnell, 2017; Watkins, 2020). Let's shift focus from the use of technology tools for learning, to learning about technology.

Digital Literacies in Canadian Schools.

Every action has an equal and opposite reaction. As the Canadian *21st Century Digital Skills* (2021) report identifies:

> The large volume of information that can be accessed through digital technologies offers a wide array of opportunities. However, because the information that students encounter is not always accurate or trustworthy, students are required to have foundational information and digital literacy skills such as critical thinking, media literacy, and the ability to verify the trustworthiness of online sources (p. 13).

As students are further enmeshed in the digital infrastructure, they need to continue to develop their capacities in *working with the tools* and the *living in the world*: not only technical skills, but also digital literacies. Unfortunately, curriculum documents have not yet caught up to the enthusiastic rhetoric and tone of policy documents and political announcements (Gallagher & Rowsell, 2017). In the absence of federal standards for digital literacies and digital citizenship (McLean & Rowsell, 2019), numerous inventories are referenced to meet the 21st century educator's accountability checklists. The eclectic circus continues (Hoechsmann & Poyntz, 2008), ranging from "21st century skillsets" and "Media Literacies" to "Innovative design thinking" and "Digital ethics" (Hoechsmann & DeWaard, 2015; Howell & O'Donnell, 2017; ICTC, 2021; ISTE, 2017). Researchers have also found that digital literacies are not yet properly accounted for in literacy assessments, missing the digital writing and multiliteracies evoked in digital literacy entirely (Slomp, et al., 2014).

In their report for MediaSmarts, Canada's *Centre for Digital and Media Literacy,* Hoechsmann and DeWaard (2015) define digital literacy as a combination of "technological capacities, intellectual competencies and ethical/behavioural comportments" (p. 4) They propose a tripartite framework bounded by access to orient the goals of Canadian digital literacy education, arguing that learners need to have the skill to *use* applications, the ability to *understand* digital media tools and content, and that they must gain a level of expertise that

allows them to *engage* creatively with digital technology. This *Access, Use, Understand, Engage* model is in many ways analogous to literacy education. The ability to critically understand and creatively develop one's own voice with a language requires a foundational fluency in the language, one which is predicated on access to language in the first place. The model also draws on the Jenkins (2009) New Media Literacies.[9] In their report, Hoechsmann and DeWaard (2015) also examine how each province has taken up the challenge of teaching digital literacy and digital citizenship.

Digital Literacies.

Unsurprisingly, the approach varies significantly from province to province. For example, in British Columbia, curriculum documents address digital literacy specifically, defining it in terms of appropriate use of digital tools for engaging with knowledge critically and creatively, and communicating with others, weaving together *ways of thinking*, *ways of working*, and *tools for working*. In Ontario, digital literacy outcomes are present across the curriculum, rather than being regarded as a subject area in its own right. Each subject area has a section entitled "The Role of ICT in Curricular Area X", and some version of the following:

> Information and communications technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support students' learning [in the curricular area]. ICT tools include multimedia resources, databases, Internet websites, digital cameras, and word-processing programs. Tools such as these

[9] NMLs are summarized as play, performance, simulation, appropriation, multitasking, distributed cognition, collective intelligence, judgement, transmedia navigation, networking, negotiation. These are understood as competencies because they are responses made up of skills and attitudes. For example, *play* is understood in this model as ones "capacity to experiment with the surroundings as a form of problem solving", and *networking* as the "ability to search for, synthesize, and disseminate information" (Jenkins, 2009)

> can help students to collect, organize and sort the data they gather and to write, edit and present reports on their findings. Information and communications technologies can also be used to connect students to other schools, at home and abroad, and to bring the global community into the local classroom. (Hoechsmann and DeWaard, 2015, p. 5-6)

In comparison with British Columbia's approach, this section doesn't speak directly to *ways of thinking*, or any kind of critical engagement with digital literacies. While provinces in this country can and should maintain the right to set their own curriculum, this fragmentation poses serious challenges to our expectations of young people and their performance with respect to sophisticated ICT competency and digital literacies. Considering this fragmentation and the absence of assessment for these literacies (Slomp, et al, 2014), there is currently no way of effectively assessing the quality and outcomes of digital literacy education in this country; despite the importance of a 21st century education, it is difficult to tell whether Canadian schools are providing a good one or not.

In the province of Ontario, this fragmentation is further compounded. While the Ontario curriculum was one of the earliest global adopters of media literacy curriculum (Poyntz & Pedri, 2018), the Ministry of Education has no standardized model for digital literacies and each school district works with its own set of competencies. For example, the Toronto District School Board (TDSB) has its own list of ICT competencies, organized by grade level (which they developed from the ISTE Standards for Students). These standards weave together *ways of thinking* and *working*, *tools for working*, and *living in the world* into seven core competency profiles,[10] but

[10] Help students use technology to be active participants in their learning goals, and to use technology to develop knowledge and learning experiences; Encourage design and computational thinking strategies, and creative output across tools and platforms; and orient students towards the world,

emphasize learning *with* technology over learning *how to use the tools*. In this model, technology represents a means to an end, and students learn *with* technology, rather than *about* technology (ISTE).

Digital Citizenship.

With respect to digital citizenship, British Columbia draws directly from the Digital Citizen competency present in the ISTE standards, whereas Ontario policy uses the Citizen Education Framework (CEF) as the basis for digital citizenship. It highlights issues of privacy, safety, and responsible use for students, seeking to develop "citizenship knowledge, skills and attitudes, such as conflict resolution, collaboration, stewardship, perspective, interconnectedness and empathy and respect" in students (Hoechsmann and DeWaard, 2015, p. 12). Notably, there is no curriculum policy for the province, leaving schoolboards to determine their own standards.

What Do Teachers Think?

Given the lack of federal and provincial standards, and the ensuing confusion over what it is that makes up a "Canadian 21st century education", it's pertinent to check in with what *teachers* think is important to teach. In 2021, the *21st Century Skills* report asked teachers to rank from most to least important the following 'human' and 'technical' skills: [11]

- Human Skills: Critical Thinking, Communication (Language/Etiquette), Adaptability, Creativity, Learning Autonomy (Independence), Collaboration, Determination, Computational Thinking, Problem Solving, Empathy, Curiosity, Confidence, Resilience

working with others both locally and globally, and developing citizens who understand their rights and act with an ethical orientation towards the interconnected digital world (ISTE, 2016).

[11] The "competency vs. skill designation issue rears its ugly head! Some of these are competencies, while others are skills, but they have been rolled up all into one.

- Technical Skills: Digital Citizenship (Data Privacy, Media Literacy), Fluency (Knowledge/Navigation/Digital Awareness), Coding; Information/Data Management; Project Coordination; Marketing; Financial Literacy (p. 31-32)

I've highlighted this survey because it is evocative of the dizzying feeling one gets when trying to engage with 'digital literacy' in Canada; the sense that the term has become a catch all, where a series of skills and competencies are swept under a convenient label and tucked away as 21st century skills. Treating 'Digital Citizenship' and 'Coding' in the same category underscores the level of confusion from educational stakeholders about what digital literacies really are. Are they technical skills, such as knowing and using JavaScript, which might age out rather quickly in terms of helpfulness for employability? Are they critical capacities? Is digital citizenship the same thing as media literacy? Is financial literacy a uniquely 21st century skill?

In Summary.

Despite the level of enthusiasm from many stakeholders in the education ecosystem about the importance of teaching digital literacies and ensuring Canadian students are able to engage critically in a data-drenched society, fragmentation about what digital literacies really are abounds, resulting in uneven standards of practice. Given the significant links that digital literacy has to success in the digital world, this confusion over description and assessment seriously undermines the quality of Canadian ICT education. In an effort to analyze the effects of this in context, let's narrow the focus further and take a look at the effects of ICT policy in Ontario.

Education That Works For … Whom?

According to the results of the *Annual Ontario School Survey*, principals across the province feel that despite being one of the higher performing education systems in the world, organizational challenges, policies, and budgets undermine the goals of education in the

province, leaving it lagging behind others (Watkins, 2020). These budget cuts have impacted at many levels: staffing, support, and arts funding, to name a few. In a move that many consider motivated by cost-cutting potential, Ontario High Schools have undergone a significant policy shift with respect to ICT integration and digital learning: moving online. With "Education that Works for You", an educational policy initiative announced in 2019, the Ford government mandated four credits for secondary students in the province be taken online (Naylor, 2019).[12]

E-learning in Ontario.

As a fully immersive, technology-mediated experience for teachers and students, e-learning is the apotheosis of tech integration into the classroom.[13] Unfortunately, analysis of Ontario's e-learning platform suggests it is a commodified, inequitable space that is unable to cope with the kinds of diversity it purports to support (Farhadi, 2019). E-learning is often treated as a route to freedom from elements of the school day with which they would rather not engage (in-class presentations) or as a way to accommodate busy schedules outside of school. Moreover, e-learning turns out to be a predominantly passive learning experience, in contrast to the calls of active engagement in tech-enabled learning. As one student in Toronto expressed: "There's no incentive for me to truly learn the material because I'm not really tested on it … It just feels like a checklist for me. A very tedious checklist" (Farhadi, 2019, p. 96).

In this model, education is not about learning. Perhaps this is the dream of trickle-down economics perverted: the neoliberal values of productivity and efficiency have taken up root in the hearts and minds of Canadian youth, with learning understood as market optimization, i.e.

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[12] This has since been downsized to two after widespread concern, with the potential for parents to opt-out – thought it remains unclear how they will do so (Alphonso, 2019).

[13] In an effort to offer a productive treatment of online learning in Ontario, outcomes associated with emergency pandemic learning are not considered in this document.

getting the right percentage. While it would be incorrect to suggest that Ontario fails to assess learning competencies such as teamwork and collaboration, these competencies are not valued by students or parents because they are not *really* valued by the system:

> I get questions every year about, 'Why can't I get my marks a little bit higher?' No one's ever said, 'Can you get collaboration [learning skills] bumped up from a [satisfactory] to a [good]? My parents really want to see [good collaboration] …I don't think that they really have any impact on the student. And I could be wrong. But I've never had a single conversation where they've said, "What's up with this satisfactory?" That's never come up. Because that's not the currency. The currency is the percentage. (Farhadi, 2019, p. 206)

Equity and Exposure.

Despite the need for internet connectivity to run almost all of the "creative and collaborative" digital technology environments recommended, under three quarters of Ontario schools currently have WiFi that covers every classroom (Watkins, 2020). The socio-economic status (SES) of families across Ontario impacts students' experiences with ICT; for example, 77% of elementary schools in which the families are categorized as high-SES offered after school clubs in robotics, technology, or STEM, yet only 57% of schools with low SES families offered the same (Watkins, 2020).[14] This disparity is also felt by infrastructure and skill gaps

[14] The TDSB's ICT Standards are guided by the International Society for Technology in Education's Student Standards and these standards map out sample learning activities with technology for teachers according to specific age brackets (4-7, 8-11, 11-14, 14-18). They require, at minimum, four laptops and four tablets per classroom, with most calling for 1:1 classrooms and or Makerspace studios (Brooks-Young, 2017). While this may be realistic for some schools, this level of technology investment and expertise is not feasible for many of the lower SES schools in the TDSB (Farhadi, 2019). This means low-SES students are missing out, even in districts with specific ICT standards.

between rural and urban communities in the province (ACORN Canada, 2019; Zarifa, 2019; Chen, 2015; Hoechsmann & DeWaard, 2015). Despite consistent rhetoric around the power of these technologies to provide new opportunities and meet the needs of individual students, many of Ontario's neediest students are left out in the cold, as these "transformative technologies" continue to reify the structures of power and inequality that have long existed in this province.

Despite evidence of digital device distraction for students (ICTC, 2020; Ward et al., 2017; Karsenti, 2015), and ensuing cost of screen-stacking (Rogobete et al., 2021; Uncapher & Wagner, 2018), administrators have failed to meaningfully address recreational cell phone use in Ontario's classrooms. In 2019, the Provisional Code of Conduct prohibited the use of cellphones during instructional time (Government of Ontario, 2019) but only 28% of elementary schools and 6% of secondary schools have actually followed through with these bans, with 67% of elementary schools and 88% of secondary schools reporting that cell phone use is up to the discretion of the teacher for instructional purposes (Watkins, 2020). On one hand, this places a significant stressor on the teacher to manage the behaviour with the phone, taking time away from instructional attention and activity. On the other, it places a significant burden on the student to self-regulate and not get distracted (Ward et al., 2017). And this matters, especially for weaker students. One study in the UK examined BYOD policies which restricted cell phone use for students (Beland & Murphy, 2015). They found that students who were already high-achievers maintained relatively consistent achievement scores whether their phones were restricted or not, but low-achievement students were impacted significantly by restriction protocols and improved their scores when they did not have to regulate their phone use by themselves. The authors argue there is therefore an equitable orientation to device restriction.

Moreover, with respect to cell phone and digital device use in the classroom, the prevalence of digital devices and media exposure in the home cannot be ignored when making decisions about their use in school. In self-reported data for Ontario's most recent Student Drug Use and Health Survey (CAMH, 2021), more than 50% of high school students spent 5 or more hours a day engaged in *recreational* screen time, with 25% reporting levels of 7 hours and up. If there is evidence that our students are spending that much time outside of school engaged with screens, and there is evidence that links excessive use with health and development issues, can we justly treat technology-integrated learning for school as a safe path to academic achievement?

Moving Forward.

For many of Ontario's students, the greatest toll of the pandemic was on their socio-emotional connections and development. While achievement scores and lost learning may feature in the headlines, the picture painted by survey data of mental health in this province tells a very different story. In a time of great need, efforts to support mental health, peer interactions, empathy development, and time for creative, fulfilling work would likely have a significant positive impact on Ontario's suffering students. Unfortunately, budget cuts in the province (Pressprogress, 2021) have hit arts funding hard and show no signs of letting up – despite years of study which demonstrate their support for socio-emotional development, creativity, and overall health and well-being in students (Bolden, 2022; Farrington & Shewfelt, 2020; Fancourt & Finn, 2019; Fleming, 2010; Holochwost et al., 2021). Moreover, given the difficulty in supporting fine arts such as drama, music, and visual arts in e-learning environments, challenges to Ontario students' socio-emotional development and creativity may persist well after the pandemic is over. In truth, socio-emotional outcomes are directly implicated in e-learning, hybrid learning and inappropriate ICT use in schools, across all disciplines. The *People for*

Education report acknowledges the pandemic has brought into sharp relief the following: "Technology can be a very useful tool in education, but it cannot act as a replacement for the rich learning and human development that happens in the myriad face-to-face settings and relationships that exist in schools (Watkins, 2020, p. 1).

In Summary.

There's a lot of catching up to do, in a province that is already millions of dollars behind in its education spending (Tranjan et al., 2022). If disaster capitalism sought to break into the public sphere of education for good during the pandemic (Moore et al., 2021), it's critical that in this time of rebuilding that we seek out alternative solutions, rather than handing over public education to the EdTech industrial complex. Given the challenges posed by privacy, privatization, and unequal opportunity, we need to consider whether there are ways to build competencies for students that address *ways of thinking, ways of working, tools for working,* and *living in the world* outside of commodified software environments. In an effort to ensure that these aims are pursued without negative encroachment into student health, developmentally appropriate technology use seeks to clarify action for the safe use of technology and ICT in learning.

Developmentally Appropriate Technology Use

Researchers have observed both benefits and challenges in the interactions between digital devices and learning in young people, depending on how and why they are used. As Plowman and Stephen (2003) warn, ICT-mediated learning is not merely scaling down versions of adult hardware and software, as children are not scaled-down adults (as cited in Cameron, 2015). Emerging from the field of developmentally appropriate practice (DAP), developmentally appropriate technology use (DATU) uses DAP principles to make determinations about how best

to integrate technology into the lives of young people given the potential advantages and disadvantages. Recommendations across the field call for technology to be used in ways that support development, privileging experiences which are active and collaborative, and restricting passive "drill and shill" encounters.

What Is Developmentally Appropriate Practice?

Developmentally appropriate practice (DAP) aims to support the healthy growth of a child from birth to maturity as they move through different developmental stages. Curriculum choices, instructional strategies, tools, activities, and expectations are tailored to the developmental stage of the child. Implicit in this approach is the supposition that healthy growth necessitates certain things happening at certain times. Correspondingly, unhealthy deviation from these stages can result in poor growth and development, potentially even a stunting of the eventual adult. Cognitive, socio-emotional, and physical development are understood to overlap each other rather than exist in isolation; growth in one area supports growth in others and challenges in one area can hamper development in another.

National Association for the Education of Young Children

The National Association for the Education of Young Children's (NAEYC) Position Statement on Developmentally Appropriate Practice provides the de-facto backbone for DAP since its inception in 1999. It suggests that DAP attends to the developmental stages[15] of all young learners and their unique needs as individuals, while educating them with respect to their

[15] The NAEYC highlights development in the physical, cognitive, socio-emotional, and linguistic realms. For the purpose of synchronicity across sources, linguistic development is treated in this work within the sphere of cognitive development. It is important to note that the value of developmental 'stages' as a key word is called into question in this position statement, with a proposal that the non-exclusive "waves of development" (p. 10) be considered, instead.

culture and context (NAEYC, 2020) and defines developmentally appropriate practice as a method for education which seeks to ensure "optimal development and learning" (p. 5) for children (up to age 8). The NAEYC underscores the link between cognitive competency (skills like executive function, focus and attention, working memory, self-regulation, reasoning, problem solving, and approaches to learning) and the socio-emotional well-being and physical activity levels of the child. Simply put, taking time for play and social activities can actually help children improve cognitively.

The statement highlights the importance of play, noting that joyful learning fosters self-regulation, language, cognitive and social competencies as well as content knowledge across disciplines. This emphasis on play is framed as somewhat at odds with more traditional approaches to learning which emphasize discipline, rote memorization, and test-taking, with the observation that some studies have found rote learning and memorization of math curriculum are less effective than teaching strategies which create a space for the individual's existing knowledge and experiences. The child's learning environment can determine their sense of "belonging, purpose, and agency" (p. 11), playing a critical role in their motivation (or lack thereof).

Functionally, the statement is intended to be used as a set of guidelines for teachers as they make decisions about instruction. The goal of developmentally appropriate practice is that children reach their full potential. It asks teachers to consider the following when they plan instruction for children: evidence-based research on general developmental stages and learning, the unique characteristics of individual children, and the context/environment of learning. Rather than try to slot learners into rigid schedules and programs, educators should adjust their expectations to fit the unique needs of learners.

NAEYC and Developmentally Appropriate Technology.

The NAEYC notes that when "used responsibly and intentionally" (p. 13) tools such as digital devices and interactive media can be helpful supports of learning and development. Technology can support communication between schools and families (especially in the case of language barriers) and adaptations for students with disabilities or isolation challenges. Despite these recommendations, the statement does caution against the use of technology, citing the links between screen time and childhood obesity, in addition to observations of decreased "fine motor, communication, and social skills" (p. 13) in young children as a result of digital device integration. The statement encourages these use-cases to be "active, hands-on, engaging, and empowering" (p. 13), offering children as much autonomy as possible when using technology and empowering them to search out new content, rather than passively receiving it. It also suggests that technology can be helpful when it provides an "adaptive scaffold", allowing children to remain with the group while developing at their own pace.

The Field of DATU From 2009-2021: A Summary Of Significant Work

If the NAEYC position statement seeks to address some elements of appropriate technology use, independent researchers have also worked to clarify recommendations for appropriate practice in classrooms. Since 2009, a number of articles with guidelines for practice have emerged under the subject heading "developmentally appropriate technology use".

Goal of DATU.

Originating in an article by Rosen and Jaruszewicz (2009), the term developmentally appropriate technology use is defined as the use of technology which respects the unique challenges presented by children's development levels and helps them learn actively and collaboratively. DATU emerges when teachers integrate their own knowledge of technology and

instructional strategies to develop lessons in which technology resources are used to support the unique needs of student, noting that these specific interactions with technology should encourage collaborative problem solving and play. Much like constructivist teaching practice, this approach to teaching and learning regards children as constructors of knowledge and recognizes the interactive processes at work in both children's development and learning.

Digital Literacy Development

Rosen and Jaruszewicz (2009) propose a five-part framework that outlines what teaching technology literacy from a developmentally appropriate perspective looks like. They recommend that teachers and teacher educators should:

> 1) Become technologically literate themselves; 2) Understand the developmental and cultural characteristics and particular needs and interests of their students as related to technology; 3) Make responsible choices about access to technology, equipment, and media; 4) Know how to scaffold children's technology exposure and experiences with appropriate expectations and strategies; 5) Engage in regular documentation and assessment of children's emerging technological competencies and literacy (p. 167).

For example, technology literacy in teachers means that they should not only be comfortable using technology, but they should be able to think creatively about how to use both teaching and learning tools to improve instruction, in much the same way we think about "finger paints and crayons as tools that expand the range of potential creation and encounter with new ideas" (p. 168).

DATU in Context

To outline the complex network of interactions that render an instructional strategy with technology appropriate or inappropriate, Rosen & Jaruszewicz (2009) sketch out two scenarios.

In the first, a second-grade class works with computers in the classroom and a computer lab at the school. The teacher uses an overhead projector and Smart board for whole-group instruction. Students get 15 minutes of scheduled computer time in the classroom each day to work on typing and word processing skills. The computer lab automatically loads drill and practice software for multiplication questions aligned with the state proficiency exam. Children frequently argue about computer time and stations, complain about their dislike of the software, and generally exhibit off-task behaviours. Some students struggle to keep up with the pre-set pace of the multiplication exercises and get frustrated. The teacher functions mostly as a disciplinarian attending to classroom management, especially in the computer lab.

In the second scenario, a kindergarten class at an experimental school uses computers and other tools to investigate a subject in which the group of students have expressed an interest. They use email, digital recorders, Smart boards, and digital cameras to generate knowledge together and organize it in a way that is meaningful to them, eventually creating a reference book about what they have learned. Finally, they create a movie that summarizes what they have learned. The teacher uses digital resources to track the progress of students and assess their learning.

Uptake of ICT in the Classroom.

Use of technology in the classroom is typically correlated with a teacher's knowledge, self-efficacy, and perceived usefulness (Brye, 2013). Some teachers are resistant to technology integration because they are concerned about the negative effects of technology use with young children or concerned that mediation through digital interfaces interferes with their relationship with the student (Rosen & Jaruszewicz, 2009; Parette et al., 2010). The Alliance For Childhood's position statement *Tech Tonic* is representative of these concerns. Generally speaking, use can

edge out time for other important developmental activities (also known as the displacement theory), screens may impact healthy brain development, and media content can be harmful (especially violence and advertising) (Alper, 2013).

DATU advocates contend that ICT integration can take place appropriately and safely, promoting active and collaborative learning. Without proper training however, teachers may export passive learning into digitally mediated environments. For example, early adopters of floppy-disk software merely replicated the functionality of worksheets, enforcing a passive learning experience (Rosen & Jaruszewicz, 2009). Notably, although pacifying technologies do not align with the underlying principles of developmentally appropriate practice in education, examples of passive technology use such as "displaying pictures" or "showing videos in PowerPoint stye software" persist in good practice scenarios proffered by some advocates (Parette et al., 2010), suggesting the line between appropriate and inappropriate use remains blurred.

Appropriate Use.

Because of the potential risks to development and lack of consideration in the design of educational software, educators and teachers need to make decisions about which teaching tools to deploy for the betterment of their students, and to consider technology access, student privacy and other vulnerabilities through the developmentally appropriate lens. The "appropriateness" of the choice of technology is often correlated with other instructional choices like grouping and scaffolding (Rosen & Jaruszewicz, 2009). Interviews with teachers and instructional designers have highlighted that perceptions of appropriateness fluctuate depending on the type of technology used (Blake et al., 2011) but found that instructional design professionals were slightly more willing to recommend the use of technology for children than teacher

professionals. Determining "appropriateness" places significant responsibility on teacher training programs and teacher educators to ensure teachers have the knowledge and skillset to help children succeed with technology in the classroom (Rosen & Jaruszewicz, 2009).

Pre-Packaged Solutions.

Unfortunately, many commercial developers of educational software still fail to design with developmentally appropriate principles in mind and teachers should not rely on pre-packaged "approved" software, as these can shortcut the teachers own process of reflection and judgement around what their unique students need (Rosen & Jaruszewicz, 2009). Depending on the culture, context, and needs of learners, these one-size-fits all software solutions can easily backfire (Rosen & Jaruszewicz, 2009).

What About Adolescence?

Research in this field has focused primarily on early childhood contexts and outcomes, despite the reality that adolescence is a critical period of development – especially with respect to socio-emotional outcomes and higher order thinking skills (Mills, 2016; Giedd, 2012; Marin & Halpern, 2011). It is during adolescence that emotional and cognitive regulation capacities start to develop; a time in which the stability, resiliency, and independence of the future adult is forged (Goldfus & Karny-Tagger, 2017). Recommendations exist for tailoring effective instruction to the developmental stages of pre-adolescents and adolescents (Meschke et al., 2012), yet these have not been taken up in the literature to support appropriate technology use. In truth, there is limited evidence of literature within the field of education which looks at developmentally appropriate practice in contexts *outside* of early childhood education (Meschke et al., 2012). As a result, despite the proliferation of research into adolescent development stages, it may be difficult for educators to locate evidence-based research that helps them tie specific

instructional strategies to those developmental stages (Goldfus & Karny-Tagger, 2017; Meschke et al., 2012).

While much of the research (and certainly the headlines) focus on social media addiction, let's dive into contemporary research on the effects of digital device use for today's adolescents in an effort to clarify the potential advantages and disadvantages for healthy development and learning outcomes.

Effects Of Digital Device Use on Adolescents

Caution around young people's use of digital devices has existed since the early days of television and many elements of that moral panic or alarmist rhetoric are still echoed today (Adorjan & Ricciardelli, 2021; Poyntz & Pedri, 2018; Giedd, 2012). While research into the impact of digital devices on young people remains in its infancy (Gottschalk, 2019), mental health practitioners and parents are concerned about behavioural challenges associated with screen use such as attention difficulties, impulsivity, and moodiness (George & Odgers, 2015; Dunckley, 2014). Overstimulation is a factor in many people's lives, interrupting reflection or thinking about ideas, plans, situations, and disrupting social interaction and quality time with others (Robson, 2017). This is amplified by the commodification of attention online (Lanham, 2006).

Much of the research that examines the impacts of digital device use has focused on the negative impacts of excessive screen time in young children, and when research turns its eye to adolescents, the focus is typically on internet or gaming addicted patients, whose brain scans demonstrate significant changes in executive functional capacities such as attention, decision-making, and control, as well as emotional processing (Alter, 2017; Lin et al., 2012). Given the uniqueness of those cases, it's easy to dismiss them as extreme. But consider this: based on

findings from the *Adolescent Brain Cognitive Development (ABCD)* study, Nagata et al., (2022) determined that typical US adolescents (aged 12-13) were spending an average of 7.7 recreational hours engaging with screens per day during the pandemic. According to the OECD's standards, "extreme internet use" exists when users spend more than 6 hours per day online (Gottschalk, 2019). While the results of studies conducted with "addicted" adolescents should not be applied wholesale to typical adolescents, the case for their more general applicability is growing with engagement, and a case can certainly be made that the pandemic forced many adolescents into a prolonged period of "extreme internet use". Furthermore, the lines between recreational and educational use are blurry; use that is understood to be "instructional" is increasingly difficult to differentiate from recreational. For many adolescents, operating without their phone, tablet, or computer is increasingly challenging – not just functionally, but emotionally. As such, it's important to understand the impact of screen use on the developmental health of adolescents and how it intersects with their well-being.

Impacts On Physical Health.

For many adolescents, ICT can provide access to information about health and exercise, and potentially improve physical activity levels with the use of wearable technologies and free exercise content (Wartella et al., 2016). It can lead to challenges with eye health, such as myopia and blurred vision (Dresp-Langley, 2020; Lanca & Saw, 2020; Toombs, et al., 2022), and it can also lead to physical discomfort, especially neck and shoulder pain due to posture issues, sore eyes due to eye strain (Scherer & Hatlevik, 2017; Dockrell, et al., 2010). Correlations have been observed between headaches, neck pain, and screentime (Toombs, et al., 2022; Smith, et al., 2008). It has also been linked to increases in sedentary behaviour and lower rates of exercise in

pre-adolescents (Dresp-Langley, 2020; Robinson et al., 2017; Stiglic & Viner, 2019; Toombs, et al., 2022) and increasing rates of obesity in Canada (Government of Canada, 2021).

Researchers have observed that adolescents often sleep with their notifications on, waking to check social media in the middle of the night, and some even sleep with their phones in their hands (Rosen, 2017). Blue light impacts melatonin production and disrupts circadian rhythms (Toombs, et al., 2022). As a result, digital device use poses challenges to sleep hygiene and is a common cause of lost sleep amongst adolescents (Government of Canada, 2021). This is significant not only for the negative impact that lost sleep has on memory, encoding, and learning outcomes (van den Berg et al., 2022; Wagner et al., 2004; Walker, 2005), but also because lost sleep directly contributes to "daytime dysfunction" (Government of Canada, 2021), negatively impacting attention and concentration, and leading to learning loss (Hayes & Bainton, 2020). Notably, evidence exists that persistent lost sleep in early years can impact functionality later on (Taveras et al., 2017).

Impacts On Cognitive Health.

Undoubtedly, access to digital devices affords access to new information and new ways to learn. Social media platforms allow students to communicate about their classes and access study resources from around the world. Perhaps the most robust transformative power is the possibility for exposure to new ideas, new ways of thinking and tools for creating, and access to resources beyond our geographical location. As educators have identified, however, this "data-drenched" information landscape can be difficult to sift through. Robertson (2001) highlights the ways in which *data*, *information*, and *knowledge* have become increasingly synonymous terms, but knowledge implies a level of personal understanding and meaning-making – especially within a socio-constructivist orientation. By contrast, information and data need not necessarily

be “understood”. Given the easy accessibility of information – presented cleanly and consistently on Wikipedia, for example – there is little motivation to “know” things anymore. The impact of which, as many of today’s students can attest, is that whatever subject or process they need to demonstrate knowledge of is abandoned to make room for whatever test or project is next. The result is that a great deal of information is getting moved around without being understood, which makes it difficult to engage with it critically or meaningfully. Moreover, engagement with information in the attention-economy of Web 3.0 – quick flashes, limited bursts, headlines, and video clips – often breaks up our “unfolding phenomenal consciousness”, interrupting one’s thinking processes and making sustained focus or concentration increasingly rare (Carr, 2011; Robson, 2017). While these tools certainly provide access to new information, it’s important to consider the impacts of the resulting information overload on higher order thinking skill development.

Clickbait headlines such as “Experts Warn Computers Stop Youngsters From Seeing the Bigger Picture” play up fears around technology “rewiring” young people’s brains and sabotaging their cognitive capabilities. While it’s true that neurons that fire together, wire together, the interaction between device use and cognitive development is far more complex than a cellphone or video game “re-wiring” the brain (Gottschalk, 2019). Research remains inconclusive as to what impact digital devices have on the full spectrum of cognitive development in adolescents. What is certain however, is that while genetics play a significant role in cognitive development, environment and exposure matter, too, because adolescent brains are primed to adapt to changes in their environment (Giedd, 2012; Gottschalk, 2019; Meredith et al., 2022;). Since adolescence is a critical period for the *improvement* and *specialization* in the brain, young people’s interactions with digital devices can play a constitutive role in how their

brains change during this period (Johnson et al., 2007). Rather than trying to describe whole brain effect, let's take a look at some of these interactions between digital devices and specific cognitive processes that are "training the brain" at this critical developmental period – and how they can intersect with academic performance.

Memory, Learning, and Problem Solving.

Digital device use has been found to decrease memories of an event (Tamir et al., 2018). While some advocates point out that students are merely adapting to the possibility of easy information retrieval and that lower information retention is at least balanced by reliable memories of where online one can find that information (Sparrow et al., 2011), others counter that the presence of devices which provide access to information undercut information processing and learning (Spitzer, 2014). Easy availability means that *information* is less likely to be transformed into *knowledge*, i.e. to be understood. Furthermore, the presence of internet-based solutions can actually encroach on the development of problem-solving thought patterns; when answers to a cognitively challenging problem are readily available (either through networked peers or internet access), students are less likely to learn and later deploy the appropriate analytical reasoning (Rahwan et al., 2014). This is a commonly observed problem in both online and in-school learning: the availability of a quick answer to a question undermines the learning process that the question intended to develop.

Reading, Writing, and Comprehension.

The shift from traditional to electronically mediating reading and writing makes for easier access and editing, but the tradeoffs at the cognitive level are substantial. Handwriting has a positive impact on brain development and motor skill development and is linked to learning and memory (Spitzer, 2014; Wollscheid et al., 2016), and as schools shift away from requiring

cursive writing, in favour of typing, these learning outcomes are lost. Word processing can also decrease memory for rudimentary writing skills, such as spelling (Peterson & McClay, 2012). As reading activities increasingly take place online, practitioners are noticing a shift in reading strategies, with students employing hyper reading tactics (such as skimming and scanning) in favour of deeper reading strategies, and that the two use (and therefore wire) different processing patterns neurologically (Carr, 2011; Hayles, 2012). Hyper reading has been linked to lower comprehension outcomes, which lessens the potential for critical engagement and analysis (Delgado et al., 2018; Hayles, 2012; DeStefano & LeFevre, 2007).

Multitasking.

Multitasking taxes the brain's attentional capacities by forcing it to shift back and forth quickly between tasks, costing time and energy and resulting in lower performance (Giedd, 2012). Media-multitasking studies conclude that working memory, long term memory, attention, executive function, reading comprehension, relational reasoning, and problem-solving abilities are negatively impacted in individuals who engage in heavy media-multitasking (engaging with multiple forms of media at a time, such as texting while watching a movie) (Rogobete et al., 2021; Canadian Pediatrics Society, 2019; Uncapher & Wagner, 2018; Ophir et al., 2009). Unfortunately, these "screen-stacking" behaviours are a common modality of engagement for adolescents. In a media-multitasking study of adolescents, Cain et al. (2016) found that frequent media multitasking in daily life correlated with reduced executive function (working memory) and worse academic outcomes in real-world assessments of math and English. It was also linked with behavioural challenges such as higher rates of impulsivity and lower rates of growth mindset. While this research does not make any connections between media-multitasking and ADHD, the overlap of attention challenges and impulsivity are noteworthy (Toombs et al., 2022)

Attention and Distraction.

The mere presence of a device – not even a cellphone sending out rapid fire notifications – drains the available cognitive, attentional, and executive functioning resources of participants (Ward et al., 2017). Notably, this cognitive cost was more pronounced in users who reported smartphone dependence in their daily life.[16] They also found that this cost was consistently underestimated by participants, meaning they were unable to recognize the real impact of the device on their executive functioning.

The average adolescent finds it difficult to study for more than 15 minutes at a time, and when they are asked to do so, will often lose more than five minutes of 15 minutes to texting and social-media related distraction (Rosen, 2017). Rather than dropping into the intense periods of flow and deep focus which are critical for problem-solving and other higher order thinking skills, devices frequently disrupt attentional resources (Spitzer, 2014), and the speed of media has also been found to disrupt a student's ability to settle into the slower pace necessary for complex classroom work (Xu & Jang, 2017). Moreover, many adolescents are so tuned in to what is happening online that the anxiety around missing anything (FOMO) compels them to check their phone, disrupting their sustained attention (Rosen, 2017). As a result, many students feel increased stress around schoolwork because it takes longer for them to complete it (Rosen, 2017). And if neurons that fire together, wire together, these devices can pose a significant stopping block in the development of that critical 21st century problem solving building block: comfort in uncertainty.

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[16] This was measured using an assessment which ranked responses to: "I would have trouble getting through a normal day without my cellphone". Given the statistics on use, most adolescents would likely rank this quite high.

For many teachers, this struggle to work through cognitively taxing material is an all-to-real classroom reality. In Common Sense Media's (2012) survey, teachers felt their students struggled to work through challenging assignments and that instant rewards have made "depth of commitment much harder […] They don't want to put effort into areas that don't give them instant gratification". Another commented "If they cannot get what they need quickly then they will give up" (as cited in Rosen, 2017).

Impacts On Social/Emotional Health.

Digital devices facilitate connection with others, which is important for healthy development. Communication with friends and family, especially when they live far away, are aided through digital devices, and life online provides a space for meeting new people who have similar interests, helping adolescents to develop their hobbies, knowledge, and experiment with their identity and self-expression (Government of Canada, 2021; Canadian Pediatrics Society, 2019). There's also evidence that teens use the internet to improve their mental health outcomes, seeking out support or providing a space to air out their feelings (Odgers & Jensen, 2020; Public Health Agency of Canada, 2020; Canadian Pediatrics Society, 2019).

Unfortunately, adolescents who are struggling with socio-emotional connections may actually fare worse engaging online. As Kraut et al., 2001 argues, "the rich get richer" (as cited in Graafland, 2018). Social comparison is a very powerful force for adolescents, and the content and structure of their online experiences can often increase feelings of loneliness, jealousy, and unhappiness with their own life, negatively impacting their self-esteem, optimism, quality of life, and resilience (Toombs, et al., 2022; Government of Canada, 2021). Excessive internet and screen use has well-documented correlations with negative mental health outcomes such as depression and anxiety (Toombs, et al., 2022; Boers et al., 2019) and mental health can be

negatively affected even when students *aren't* permitted to be online: the 2015 PISA assessment reported that 50% of students surveyed said they "felt bad" when no internet was available (Graafland, 2018).

While social media can provide a support system for adolescents, it's wrong to assume live interaction and texting can be swapped out interchangeably. Face to face engagement brings with it neurochemical release and emotional regulation, a kind of closeness that is only possible in real life: as Hillarie Cash, [founder of reStart] articulates: "if you only ever spend time online, a part of you withers away" (Alter, 2017, p. 230). Some studies have also found that problematic social media and video-game use may stall the development of empathy in adolescents and complicate their ability to develop meaningful relationships with others and negatively impact prosocial behaviours (Alter, 2017; Toombs et al., 2022).

Addiction.

Ask most teachers in K-12 education how they feel about phones in the classroom and they're likely to remark how "addicted" the students are to their phones. Disagreement still exists around whether to categorize problematic smartphone use,[17] excessive internet and gaming use, and other forms of extreme media engagement as a true "addiction" (Busch & McCarthy, 2021; Cash et al., 2012). Nevertheless, the term is certainly being bandied about by adolescents themselves.

In one recent Canadian study (which interviewed adolescents aged 13-19 on smartphone use), participants made comments such as: "I'm addicted to social media. I cannot go a day

[17] Problematic smartphone use is understood here as: "Compulsive pattern of smartphone usage which can result in negative consequences that impair the daily functioning of the user" (Busch & McCarthy, 2021, p. 2)

without checking, or even an hour, I feel I always have to check, even if it's nothing important, it's just, it's a bad addiction […] Honestly [I'm] on mine cuz I'm always kind of bored, I'm like 'ok, whatever, let's see what's happening'" […] My phone's never not in my hand; I sleep with it in my hand!" (Adorjan & Ricciardelli, 2021, p. 53-54). Analysis of the focus group data revealed that social comparison and approval were significant motivating factors for persistent engagement with social media networks and smartphones, and that use was often motivated by feelings of boredom. For Ontario's students, the most common self-reported symptom of problematic smartphone use is failure to self-regulate ("staying on the phone longer than intended"), and this is followed by lack of sleep, decreased academic achievement outcomes, and comments from peers or parents regarding excessive use (CAMH, 2021)

These links between digital device use and behavioural addiction are not only found with respect to smartphones. Given the significant dopamine payoff across online environments, problematic use patterns can be observed in social media networks, streaming, gaming, and more (Cash et al., 2012) – smartphones are just the most common access point for adolescents at this time. Encouragingly, researchers have found that emotional regulation is a key mediator between problematic smartphone use and antecedents such as boredom, stress, anxiety, neglect, etc..[18] highlighting the links between socio-emotional health and development as an antidote to addictive behaviours (de Freitas et al., 2021; Squires et al., 2021)[19]. In essence, the more emotional regulation an adolescent has, the less likely it may be for them to allow mental health

[18] While the multitudinous cause and effect components of problematic smartphone use (PSU) are beyond the scope of this inquiry, see Busch & McCarthy's (2021) systematic literature review for a comprehensive exploration of the factors which can lead to PSU and the host of negative outcomes associated with it.

[19] Emotional regulation is understood as one's ability to deal with difficult feelings and to engage with effective coping strategies (Squires et al., 2021)

distress to spiral into problematic smartphone use. The more attention that is paid to supporting strong socio-emotional development, the less vulnerable they may be to addiction.

In Summary.

Problematic engagement with devices mirrors other forms of maladaptive strategies or self-soothing behaviours. When faced with cognitively demanding tasks, anxiety, boredom, or difficult emotions, many of today's adolescents are reaching for their phones as a coping mechanism. Given the fact that humans face the highest risk of addiction in early adulthood (Alter, 2017), it's critical that schools weigh digital media engagement carefully against the potential risks. If reading online impacts comprehension and understanding, perhaps students should be provided with alternative methods of delivery to Promethean boards and iPads. Given the challenges that these devices hold for sleep, maybe long hours of homework that must take place on the computer are not such a great idea. If cellphone use is seemingly impossible to regulate for this age group, does it really need to be a part of the day-to-day instructional experience?

Unresolved Questions for The Field Of Developmentally Appropriate Technology Use

Given the threats to adolescent achievement outcomes explored above, it's important that educators and researchers reconsider the pillars of developmentally appropriate technology use and reframe their aims to include *all* school-aged children. To support effective judgements about what tools, software, instructional strategies, and expectations are appropriate for adolescents, it's also important to clarify the ways in which teachers make these judgements; the information they need to have and the type of analysis they should engage with.

What Is Technology?

While theories of learning are carefully addressed, theories of technology are not. Even well-established frameworks such as TPACK provide theories for technology integration but do not address technology in and of itself, and ensuing studies describe the definition as "fuzzy', incorporating 'all kinds of technologies', 'emerging technologies,' 'digital technologies,' or just lists of specific hardware, software and services" (Rushby et al., 2016). If Educational Technology has no unified theoretical basis (Rushby et al., 2016) and there remains no agreed upon definition of technology (Warner et al., 2018), this incoherence complicates the kinds of interdisciplinary conversations that are needed to pursue excellence in this field and efforts to successfully evaluate 'appropriate' integration in the classroom. Within the developmentally appropriate technology literature, Alper (2013) advocates a broader definition of technology, suggesting it should include any tool that helps us to work, learn and play, in contrast to the general orientation towards digital tools. In truth, technology can be thought of in terms of artifacts, knowledge, activities, or values (Rushby et al., 2016). In this work, technology is understood (in keeping with CHAT) as that which mediates human activity, ranging from tools as simple as hammer to processes such as reading.

Within DATU, more attention is needed on the nature of the interactions with cognitive tools. If technologies can improve cognitive capability in learners, how should we conceptualize this change? Solomon and Perkins's (2005) framework considers the effects *with*, effects *of*, effects *through* tool use to provide a path to thinking through the intellectual amplification of technology, but further engagement is needed to understand these interactions, especially with respect to *effects of* in K-12 learning environments.

Recommendations For ALL School-Aged Children.

Despite the fact that young people continue to develop beyond the age of eight, there is limited effort in the DATU literature to tie particular waves of physical, cognitive, and socio-emotional development to specific strategies or design of technology use for pre-adolescents and adolescents. Brye (2013) notes that children who are in the process of developing should be using technology which is tailored to support their level of development but offers no substantial evidence of what that might look like. While many teachers have a rich background in child development, many more don't. Furthermore, instructional designers are increasingly implicated in teaching and learning activities in K-12 education. If many of the instructional designers who develop the kinds of e-learning programs or blended learning software supports understand the differences between pedagogy and andragogy, it is less likely that they are familiar with the specifics of adolescent neuroscience. These interdisciplinary gaps are wide and need to be addressed.

Digital Citizenship and Moral Development

Given the importance of empathy and moral development for digital literacies such as design thinking and digital citizenship, more attention is needed to understand how DATU can bolster stages of moral development. Graber (2012) outlines the links between Piaget's stages of development and Kohlberg's moral stages of development, and digital citizenship. If pre-adolescents are still in the process of developing the "cognitive structures that enable them to grasp the abstract, metaphoric, and symbolic types of information that lead to ethical thinking" (p. 85), when can they realistically be expected to demonstrate responsible and ethical behaviour online?

Judging Appropriate Practice

In a broad literature review of developmentally appropriate technology use, Brye (2013) summarizes different examples of developmentally appropriate technology use but fails to provide compelling evidence for how to make judgements about the 'appropriateness' of the technology. This trend persists through much of the literature; lip service is paid to pre-service education, teacher training, research-based practice, and other support structures (Rosen & Jaruszewicz, 2009), but limited attention is given to how to go about the process of judging what is appropriate. Copple and Bredekamp (2008) concur that although many early childhood educators believe in the value of developmentally appropriate practice, there remains significant disagreement about what developmentally appropriate practice actually looks like. Determining *what* technology is appropriate *when* and for *whom* requires teachers to have up-to-date knowledge of evidence-based research (Kruger, 2018) and it also necessitates their freedom to try new strategies based on their observations of students' needs (since prescribing a 'one size fits all' model for developmentally appropriate practice goes against the very foundation of the approach). When teachers need to make individual judgement calls, there is limited discussion in the literature about how administrators or department heads can support and assess the appropriateness of technology use choices, and how pre-service training programs can prepare teachers for these challenging choices.

While reviewing Canadian recommendations for 'appropriate' educational apps to use in the classroom, one example underscored the complexity of these judgements for educators. The *Century Digital Skills* (2021) report acknowledges that with over 80,000 educational apps available to teachers, choosing the right one can be "overwhelming" (p. 39). They summarize "How to Choose an Educational App," an article from the *Canadian Teacher Magazine* which

advances Hirsh-Pasek et al.'s (2015) Four Pillar Model as framework for choosing an educational app. Simple enough – except that the *21st Century Digital Skills* report is intended for educators across K-12 and closer examination of Hirsh-Pasek et al.'s (2015) framework reveals it is intended for early childhood education contexts only. This is not acknowledged in the report, however, and exemplifies the ways in which teachers are receiving mixed messages (even from non-commercial sources!) in their quest to determine developmentally appropriate technology practices.

Finally, there are no recommendations in the present literature to support teachers working together to cultivate a whole-school (or at least a whole day) approach to appropriate use. For example, if every teacher decides to instruct using BYOD activities on the same day, the screen-time limits for students will certainly exceed pediatric recommendations. Confusion around how to enact appropriate practice with technology persists, and the field of development appropriate technology use requires significantly further *development* if it is to serve students, teachers, and society effectively.

In Summary.

While the field of developmentally appropriate technology use offers promising support for the healthy integration of technology into early childhood educational contexts, more work is needed to bring this practice into pre-adolescent and adolescent learning, given the challenges that digital devices pose to physical and socio-emotional health, as well as cognitive development and learning outcomes. In light of the persistent gaps in the practice of developmentally appropriate technology use for adolescents, and the challenges facing Canadian students today, this research engages with a unique pedagogical approach to developmentally oriented education in an effort to add new ideas to the field of DATU.

Waldorf Education

This section of the literature review aims to provide sufficient background into Waldorf educational theory as to contextualize the results of the study.[20] It is not exhaustive, nor is it particularly representative of the full spectrum of Rudolf Steiner's philosophical approach to education and social revitalization. In truth, Steiner's original project extended far beyond K-12 education. He sought spiritual renewal to balance the ills of scientific and secular culture, arguing that the human self was growing estranged from its true nature in the West and that it could be reconnected through a recognition of the connections between the self and the world (Ullrich, 2014; Uhrmacher, 1999). If a thorough treatment of *anthroposophy*, (Steiner's response to this estrangement)[21] is beyond the scope of this inquiry, that is because it is well beyond the scope of most families' engagement with Waldorf education.[22]

For many of the students and parents who attend Waldorf schools, Steiner's theoretical framework is invisible. What draws them to the school and holds them there are the practices

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[20] While this section provides insight into Waldorf *education*, the focus of this study rests solely on the perspectives and practices of a particular Waldorf *school*. Following Wember's distinction, the two should not be conflated (Code, 2020)

[21] Steiner's spiritual philosophy is analogous to neo-Platonist ideas of spirit (Ullrich, 2014) – specifically Plotinus' Gnosticism, which was more recently taken up by Heidegger with his conception of *dasein* and *Dasein*. Essentially, Being (be that understood as God or some other universal essence) is born into the world through human beings (being-in-the-world) and it comes to know itself slowly over the course of human life, action, and evolution over time.

[22] Despite clickbait headlines such as the Atlantic's "Is This Grade School a 'Cult'? (And Do Parents Care?)", most graduates and their families have little to no understanding of or commitment to anthroposophy (Dahlin, 2017). Moreover, a foundational tenet of Waldorf education is that teachers should not instruct students towards a particular worldview or belief system (Dahlin, 2017). The schools do not operate as a belief system like Christianity, nor purport to instill a series of values upon students. Children "belong to the future" and teachers must "leave the future open for what the new generation will bring into the world" (Dahlin, 2017). Anthroposophy is a method that supports that freedom, not a subject in and of itself.

that it produces. As such, the bulk of this review focuses on describing those practices in relation to their pedagogical justification, rather than analyzing the theory *qua* theory.

Purpose

What is the goal of Waldorf education? Most famously, the schools' approach helps young people be creative. Thorough review of the pedagogy reveals an orientation towards conscientiousness, emphasizing connection to others and to the natural world. Of course, students should be knowledgeable and competent in the skills of the world. And as a developmentally oriented practice, that goal also extends to students being fully formed, healthy, and balanced in their physical, cognitive, and social capabilities. All of these outcomes are sought after in Waldorf education, but in truth, they all emanate from a more fundamental goal: freedom. Critical thinking, self-reliance, literacy, empathy, healthy development, etc. are all necessary for the achievement of that highest outcome. This is not a freedom understood as freedom from obligation, or freedom for selfishness. It is a freedom to be unencumbered by poorly developed faculties, a freedom to trust one's own abilities and thinking, a freedom that opens up the world to a person, and a freedom to act in a way that brings good into that world. As such, Waldorf education can be understood as a practice that tries not to hinder the development of that freedom, or create obstacles for that development (Dahlin, 2017).

Teachers use specific techniques to do this, but unlike many of their public school counterparts, they are encouraged to rely on pedagogical intuition and imagination (Dahlin, 2017). There is limited emphasis on "covering everything" and little to no need to "teach to the test", as Waldorf students don't typically engage with quantitative assessment until high school. Teachers are encouraged to develop a relationship with students (Dahlin, 2017; Ullrich, 2014) and to engender in their students through the curriculum and learning activities a respect for

others and the natural world. In truth, the pedagogical approach is fundamentally *relational*. The emphasis is not on "reproducible, subject-neutral learning results, but rather on the process of understanding through the 'connection' to the world" (Ullrich, 2014, p. 103). Each student's connection to the subject matter is valued and supported.

In order to support the healthy development needed to strive, unencumbered, for that freedom, Waldorf education practices a holistic approach to teaching, using both a daily rhythm of subjects and a 12-year curriculum to offer an education to students that directly supports their physical, social, emotional, and cognitive development.

Shared Roots in Developmental Pedagogy

While the idea of children as somehow different from adults is not a new one, it was Piaget's research into the developmental stages of cognition that would provide a scientific foundation for the pedagogical approaches to developmentally appropriate practice. Neo-Rousseauian and progressive educational thinkers, such as John Dewey, Maria Montessori, and Loris Malaguzzi (Ullrich, 2014) all share this interest in supporting the developing human. Emphasis is placed on education for the whole human, and on balancing academic, artistic and practical capacities (Code, 2020). In these approaches, the child is understood to move through distinct developmental stages; if one stage is disrupted, there is a ripple effect through later stages (Ginsburg, 1982). The free development of the individual child is therefore prioritized, as are learning activities which come naturally to children (such as active, hands-on tasks, with relevant subject matter and socially-situated learning activities), and schools reject quantitative assessment in favour of long form qualitative or comment-based report cards. Practical tasks and real-life learning skills are emphasized, especially in the early years, and curriculum supports the

child as they move from concrete to abstract reasoning over the course of the 12 years (Ullrich, 2014).

Much of Steiner's practice overlaps with this progressive tradition. For both Steiner and Piaget, the development of the child is not something which can be sped up and learning activities which are beyond the stage of developmental will be difficult indeed (Ginsburg, 1982). While the work of Steiner and Piaget features significant overlap in their conception of age ranges and developmental stages, Steiner's approach pays close attention to the impact of the affective and social domain on the cognitive powers in children, in contrast to Piaget's approach.

The curriculum in these progressive approaches is understood as genetic: it is a means to an end rather than an end in and of itself (Ullrich, 2014). It is not so important that a child walks away from their class with perfect recall of what they learned; it is learning how to learn, the experience of problem-solving, that matters. For Dewey and Malaguzzi (whose Reggio Emilia system would go on to influence Howard Gardner), social interaction in the classroom is of critical importance for learning, so too for Steiner. For Montessori, Dewey, and Malaguzzi, holistic, multidisciplinary education that expressed a multiplicity of paths towards the answer was more meaningful than rote learning of right and wrong – so too for Steiner.

What separates Waldorf education most dramatically from these approaches is the role of the teacher along the developmental path. In Montessori, the teacher is construed as a learning partner or a coach: they are ready to help as needed, but ultimately play a supporting role in determining age-appropriate activities from which the students then choose their learning paths. For Dewey, the teacher is also understood as a sort of co-learner, taking on a more balanced role with respect to authority (Ensign, 1996). At Waldorf, this position is only taken up by the teacher when the student has reached adolescence; in the primary school years, the teacher maintains a

level of authority in the classroom, in accordance with the developmental needs of that age group.

One key difference that a comparison of Steiner and Dewey highlights is the orientation of the goal of education. For Dewey, the individual is for society – the aim of education is to develop a functional part of a society (Ensign, 1996). For Steiner, the goal of education is freedom for the individual, who will then go on to support a just society. Returning for a moment to Egan's distinction between the incompatible aims that sit at the heart of public education, it is evident that Waldorf education sits firmly in the third camp: serving the individual student. If skills to succeed in society or knowledge of academics can serve that goal, they are included in the student's journey. If not, they are delayed until they can. This emphasis on the production of a free, moral actor orients the practice like a north star, eliminating many of the challenges incurred in public education through its attempt to serve three masters.

Child Development as Understood By Waldorf Schools

Waldorf educators observe stages of development from birth to adulthood (Uhrmacher, 1999; Ullrich, 2008), in which a child moves from the world of senses into instinct and feeling, and eventually develops intellect and rational thinking. Physical development in early childhood is regarded as the basis for intellection and emotional development in elementary school (Schweizer, 2003). The way children learn at these early stages impacts their capacity for rational, analytical thought later in life, their courage, judgement, and moral reasoning, their willpower, resilience, and ability to withstand pressure and addiction (Maynard, 2018; Schweizer, 2003).

Generally speaking, children move from an orientation of "I do" (age one to seven) to "I feel" (seven-14) and "I think" (14-21). By Grade 1 (approximately the age of seven)[23], children are transitioning from an engagement with the world that is wholly sensory and imitative, to one in which they are developing internal senses such as memory, which allow them to build internal representations of the world. This is linked to increased object permanence (commonly observed in the advances in causal reasoning at this age), but also in their ability to consider the world on their own terms, to remember knowledge independent of experience (Ullrich, 2014), and to begin to use that knowledge in individually creative ways. They are motivated by feelings and developing the capacity for complex emotions. They learn best through explorations of the imagination, such as storytelling, and are supported by artistic tasks and tactile experiences (Nordlund, 2013). For this reason, teaching practices often include physical and rhythmic tasks for students, especially when learning academic subjects such as arithmetic. Hand clapping games, bean bag tossing, marching, and other physical activities are commonly found in the classrooms at this age, in an effort to engage the whole body of the student in learning activity.

In the middle of this period, a critical shift in consciousness occurs: the nine-year change. Children begin to turn their eye further inward and upon themselves as they start to differentiate themselves from family and from peers and recognize the beginnings of their unique self in the world (Ullrich, 2014). During this period of burgeoning self-consciousness, they also begin to see the world in more realistic ways and exhibit an interest in understanding the facts of the world around them. As they move into adolescence (14-21), their attention turns increasingly

[23] Notably, Waldorf schools require students to turn seven years old within their Grade 1 year (September-June) to ensure they are ready for the experience of Grade 1. For summer birthdays, this often means the student is asked to remain in kindergarten for an additional year.

towards the social. They begin to develop more fully their faculties in judgement, reasoning, and abstract cognition. It is at this time that independent thought, both academically and socially, rise in the individual, and they are able to engage with higher order thinking skills more effectively than pre-adolescence. This is because the mind has developed enough so that hypotheticals are actually meaningful, in contrast to the young child's engagement with the concrete, physical, and beautiful world. At this stage, they should focus on self-reflection and self-regulation, and learn well from open-ended, abstract problem-solving activities (Nordlund, 2013).

It is for this reason that Waldorf schools so notoriously delay certain academic expectations: formal academic study is de-emphasized until it is felt that the child is cognitively and emotionally ready (Kirkham and Kidd, 2017). For example, while foreign language instruction takes place as early as Grade 1, it is done through verse and song, with grammar structures introduced around the nine year change. Physics is not introduced as a discipline until Grade 6 (Avinson & Rawson, 2014; Barnes, 1991), and mechanical sciences are delayed even further. For practioners, it's not that the subject is too challenging to teach, but that introducing it too early can actually harm the child by demanding cognitive activity of them before they are developed enough to produce it (Uhrmacher, 1999) and that it can take time away from subject matter that is better suited. Reading and fact retention are not expected of students until they move into the "I feel" stage, and hypothetical reasoning and judgement are not required until the "I think". This is a particularly strange concept for many unfamiliar with Waldorf education. Why delay something as important as critical thinking or judgement?

Steiner suggested that "man is not in a position to judge until he has collected in his inner life material for judgement and comparison. If he forms his own conclusions before doing so, his conclusions will lack foundation" (Uhrmacher, 1999, p. 391). The work of the "I feel" stage is to

develop internal representations or mental pictures of the world; these pictures form the building blocks of sound judgement later on.[24] This delay underscores a concern for the *mechanism* of judgement, and the desire to support an individual's ability to trust the validity of their own thinking. Judgements which are based upon a strong internal foundation can be trusted to emerge from the individual, in contrast to judgements which are received or inherited from external sources and taken up wholesale as opinion.

The Experience of A School Designed To Meet The Age.

What does it mean to be a developmentally-oriented practice? In essence, if the child is developing into an adult, that fact should "determine what the child should learn at each age level" (Ullrich, 2014). Everything that the child experiences in their school day is carefully considered through this lens of what is "appropriate for their essence" at each stage. In truth, the concept of 'curriculum' extends far beyond traditional conceptions of what subject matter is to be taught and when. In the Waldorf context, curriculum means "any and everything that children can 'go through' in school, i.e., all actual and possible experiences, conscious and subconscious, that they are intended to have" (Dahlin, 2017, p. 83). This ranges from the architecture of the school, the design of the classrooms, the toys they play with (and more importantly, the toys they

[24] Despite its foundation in a spiritual approach, Steiner's picture of development is not dissimilar to the description of children's development in an encyclopedia, especially his emphasis on the difficulties of complex thought and judgement before the maturation of the prefrontal cortex. Nevertheless, his understanding of the *mechanisms* of development do not easily align with contemporary neuroscience and child development – nor did they align with developmental psychiatry at the time of his writing (Ullrich, 2014). Waldorf schools do not take up Steiner's work wholesale, and for many teachers, his lectures provide a foundation for their individual practice, one based on lived experience, intuition, and most importantly, on the students sitting in front of them. In this way, Waldorf education is oriented towards the healthy development of each individual, real student who enters the class, not a Platonic form of healthy development that sits inscribed in a textbook or Steiner lecture. Waldorf teachers today are actively engaged with contemporary educational research, seeking to develop their practice in light of what is true and helpful to the children they are working to support.

do not play with), the media present in teaching, the teaching strategies, the learning activities, the subject matter – even the daily schedule.

Architecture and Design.

The look and feel of the building and the classroom are understood to impact greatly on the students' ability to learn. Steiner criticized the "barbaric environment" of schoolrooms in his time and called for classrooms to be decorated artistically and harmoniously (Uhrmacher, 1999, p. 396). Being surrounded by beauty, in a space that is warm and nurturing, with colours that offer stability and good feeling, are all different tools to offer emotional support to the child and let them focus on their learning. The architectural approach of the buildings is also understood to impact on learning, eschewing straight lines and box-y buildings in favour of more naturalistic architectural shapes.[25]

Tools and Stimulation.

Classrooms use a long blackboard and chalk as the teacher's primary method of visual support for information delivery. Instead of textbooks, multimedia, or other forms of information delivery, teachers use "lively speeches, demonstrations and experiments" (Ullrich, 2014, p. 101) to hold the students cognitively and emotionally. Teachers are encouraged to use storytelling instead of textbooks because textbooks are considered without feeling, engendering a passive orientation towards the subject matter in students. If the students are to be truly engaged and connected with the teacher, Steiner argued, the subject matter must "flow from the teacher's soul" (Uhrmacher, 1999, p. 394). To create a record of learning, students generate their own textbooks, using artistic methods to draw images and write summaries of the content of the

[25] (For examples of this in practice, see images of the Goethaneum).

lessons. This helps them to translate information into their own words and therefore, integrate it more meaningfully into their own understanding.

Even something as simple as a crayon takes on significance when viewed through a developmental lens. For example, students in Grade 1 use only square block crayons. As the bones of their hands develop and fine motor skills increase, they transition to use stick crayons, and eventually specialized coloured pencils.[26]

Daily Rhythms: The Horizontal Curriculum.

Students move through the same rhythm of instruction each day (Ullrich, 2014; Uhrmacher, 1999; Barnes, 1991). In the morning, they study a two-hour block called Main Lesson. The theme changes every three to six weeks but students attend to it every day for that period, allowing for a multisensory deep-dive. After Main Lesson, students take a short snack break and then they are ushered outside for a short recess. Two academic classes take place after that recess; these operate on a weekly schedule and last for one hour each, ranging from language arts (including foreign language instruction), math, and science classes. Students then take a long lunch and recess break, which is followed by two classes of one hour each in physical education, fine arts, and technical arts classes. Notably, students are offered limited choice in their courses. While they may select for specific electives within the fine arts or technical arts offerings in high school, each has to take every subject (Barnes, 1991). In accordance with the developmental shifts of the grades, the specific content of each of these classes changes over the Grade 1-12 period.[27] Take Handwork: students start in Grade 1 with simple knitting and

[26] Most schools use Stockmar or Lyra brand, which are made of wood and formed into a triangular shape to produce an appropriate grip of the pencil.

[27] For a more thorough treatment that presents examples of all of these changes, see Uhrmacher, (1999) and Avinson & Rawson (2014).

crocheting projects. As their fine motor skill development increases, they are ready to tackle hand sewing. By Grade 8, their focus and attentional capacities make machine sewing an appropriate challenge. With Music, students begin with singing, add recorder playing and music theory to their repertoire, and eventually transition into specialized Choir and Orchestra classes in middle school (Stehlik, 2019).

This daily schedule or "horizontal curriculum" is intended to offer the students exposure to a broad range of subjects in a variety of contexts, with the goal of fully developing the different faculties of each student at each stage in their growth (Barnes, 1991). Because the pedagogy is oriented towards the "head, heart and hands", fine arts, physical education, and technical arts classes are valued as equals alongside academic course offerings. If education is to produce fully developed human beings, it must make time for activities which sustain the socio-emotional and physical development alongside cognitive activity, or risk developing emotionally stunted adults (Barnes, 1991). For example, technical arts classes offer students the chance for long-term project-based learning. While they are certainly gaining useful practical skills, these activities also provide them with problem-solving that sits right within their zone of proximal development. The tasks are challenging but doable – with careful hands and disciplined minds. Although these physical tasks most obviously develop their physical bodies (coordination, fine motor skills, sense of symmetry, etc.) they also make demands on their cognitive support structures, such as will and attention. In this way, they provide young learners a chance to work through the emotional components of problem-solving in a variety of age-appropriate contexts, preparing them for the later demands of abstract problem-solving and reasoning. Getting the chance to develop concrete skillsets which build upon each other over a 12-year period also aids students in developing self-efficacy, confidence, and discipline.

The variety of courses is intended not only to generate a wide range of cognitive and physical skills but also to provide a rhythmic structure to the day that nurtures them emotionally. As many teachers know, it is difficult for young learners to engage the longer the school day goes on. With a schedule that moves from main lesson to academic to practical courses, students focus on academics after a short break, and they are then encouraged to tap into their emotional and creative engagement in the latter part of the day, re-engaging their motivation for learning as their energy starts to flag. In this way, the school day nurtures their daily rhythm and energy levels, filling the day with rich experiences without exhausting their cognitive and executive function and causing burnout.

Moving From Grade 1 To 12: The Vertical Curriculum (Ascending Spiral).

The content of the Main Lesson is intended to speak to the interest and challenge of that age (Stehlik, 2019; Ullrich, 2014; Uhrmacher, 1999). For example, as Grade 11 students develop their sense of individuality, responsibility, and personhood (Meschke et al., 2012), they spend six weeks studying Eschenbach's *Parzival*, a thirteenth century coming of age tale which grapples with many of the same issues. Sometimes the topic is discipline-based, such as arithmetic or geology, and sometimes it is theme-based, such as the History of Islam or Global Revolutions (Uhrmacher, 1999). Observed in their totality from Grades 1 to 12, the Main Lesson *themes* are structured like an ascending spiral. For example, in the early years, students study Fairy Tales, Legends, and Fables, moving towards the study of global revolutions in Grade 8. By Grade 12, they have returned through World Literature, Existentialism, and finish with Fairy Tales. This movement from universal to specific that returns again to universal allows the student to revisit old ideas with fresh eyes. While they may have engaged with the ideas of Fairy Tales in one way as seven-year-olds, they are bringing a wholly news lens to it as 18-year-olds. This offers them a

chance to deepen their own understanding, but it's also an intentionally structured metacognitive turn, allowing for self-reflection and an awareness of the ways in which we can change our thinking.

Functionally, the three-to-six-week approach of the main lesson instruction allows the teacher and the students to get a closer connection with the topic under study.[28] Uninterrupted engagement means the class can examine the topic from multiple senses and perspectives in an unhurried manner, giving students time to process their feelings and develop a deep, personal understanding (Ullrich, 2014). Many of these themes offer students the chance to work through moral dilemmas. Teachers take an indirect approach to these morality lessons: they are unlikely to ask students to summarize the moral of the story, giving the student time to let the lesson settle in through dramatic play or drawing as they grow to understand it on their own terms (Graber, 2012).

If the horizontal curriculum speaks to the cognitive, physical, and emotional development of the student, there is something unique in the vertical curriculum's support for healthy development. Travelling through the variety of subjects in this spiraling manner encourages the development of the "I" – of a self-awareness and capacity in the individual to engage with complex ideas. In Waldorf education, the strength of the self is dependent on fully developed cognitive, affective, conative faculties (Dahlin, 2017; Ullrich, 2014).[29] If students are to engage with pure thinking (logic), that capacity is built upon feeling and internal effort (skill and will).

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[28] Notably, some educators outside of the Waldorf context have suggested that this approach means students are likely to forget what they've learned once the block is finished. Practitioners find that the connections formed to the material run deep, and the time away allows them to return to the material with fresh perspectives, renewed interest, and greater attention (Ullrich, 2014).

[29] This is similar to Plato's division of man (Ullrich, 2014).

Thinking, Feeling, and Willing: Healthy Development of the "I".

Steiner believed that the combination of thinking, feeling, and willing is necessary for advanced cognitive work (Dahlin, 2017; Huchingson & Huchingson, 1993; Ullrich, 2014). As a result, space is made throughout the school day for feeling and willing activities alongside the more traditional academic 'thinking' activities. In Main Lesson, for example, students work through *feeling* in the presentation of the lesson. The teacher uses active storytelling or a demonstration to engage the students' attention and emotion, presenting the new information creatively and artistically. This elicits internal images, imagination, emotion, and stimulates the creative life of the child (Huchingson & Huchingson, 1993). *Thinking* occurs the following day, after they've had time to think about it, and they review the lesson as a group. Structured by the teacher as a question-and-answer dialogue, this discussion asks for insight, evaluation, synthesis, and analysis, with limited emphasis on right or wrong answers (Huchingson & Huchingson, 1993). This allows students the freedom to explore uncertainty without fear of marks. *Willing* occurs when the students take up the information they have learned and transform their impression into a concrete product. That can take the form of an artistic presentation or dramatic reenactment, but most frequently occurs in the Main Lesson book work, where they draw and write what they have learned. This activity encourages the individualism and creativity of the student on one hand, while demanding focused attention and self-discipline to complete the work on the other (Huchingson,& Huchingson, 1993). This "will work" develops the capacity for sustained effort in thinking and problem-solving, paralleling the long-term project-based learning found in the technical arts.

Planting The Seed.

This approach to development is one of metamorphosis: children are not a different species from adults, but rather adults "in seed form". As a result, each experience that a child has as they mature into adulthood will be brought to bear on them as an adult. As Steiner suggests: "If true forms developed, true forces would grow; if misshapen forms were developed, misshapen forms would grow" (as cited in Ullrich, 2008, p. 73). Implicit within this understanding is that *growth* takes time: what is being taught may not re-emerge in the student immediately, just as the water and sun that a seed receives are not immediately transformed into a flower. There is this sense that the profound lessons of education (the complex competencies) need time to settle and to mature inwardly if they are to emerge as fully developed forms and capacities later on. That which can be regurgitated immediately after learning indicates a level of superficiality, either in the subject matter itself or in the student's grasp of it.

In Summary.

Waldorf education delivers a developmentally appropriate approach through its horizontal and vertical curriculum. The curriculum attends not just to subject matter, but the thinking, willing, and feeling experiences of students in an effort to support healthy development that can lead to individual freedom.

Understanding The Research Design

This section outlines the theoretical framework and research method used to support the study. It also highlights the ways in which this framework and method are well suited to the particularities of the study object and clarifies the philosophical alignment between theory and method.

Theoretical Framework

This study uses third generation Cultural Historical Activity Theory as its theoretical framework. CHAT examines complex sites which contain a multiplicity of perspectives and goals within a system of collective action, such as schools or hospitals (Foot, 2014; DeVane & Squire, 2012). It is important to clarify that 'activity' in this sense is not delimited as a particular 'behaviour' but rather as a 'process-as-a-whole', and that activities are understood as definite responses of subjects *towards* objects (which come to an end when the goal is considered to be achieved) (Foot, 2014; DeVane & Squire, 2012). In the case of a school, the most immediate 'activity' is the interactions between teacher and student. CHAT seeks to look deeper and clarify what other components within the activity system are acting upon this dyad and helping to produce the resulting interaction. This process of inquiry breaks down the system into six components: (1) subjects/actors, (2) objects (sometimes described as goals or desired outcomes), (3) tools, (4) communities of significant others (5) rules, and (6) divisions of labour.

Looking more specifically at research into developmentally appropriate technology use, this process of clarifying patterns of influence by breaking down the system into components is helpful. The following explanatory example borrows heavily from Foot's (2014) use of the narrative vignette to explain CHAT in healthcare settings:

The subjects within a developmentally oriented school activity system could be the students or teachers, with an object that might be defined as of 'educating them in a way that is healthy for their development'. Teachers use different tools, such as instructional strategies, computers, or whiteboards to achieve that object, and interact with significant others (or stakeholders) who are invested in the same goal but may understand it differently (such as parents). There are rules that they have to follow (such as attending classes, being respectful, and

obeying curriculum requirements and provincial directives) and a division of labour at the school about who is responsible for each step in the educational process (teachers, teaching assistants, administrators, students, parents).

While there are levels of complexity present in each of the six components, the second component (objects) requires significant explanation in this particular analogy as it is the greatest source of potential contradiction. In CHAT, objects have three facets. The first facet sees the object as a 'thing-to-be-acted-upon' or 'the student's educational journey'. The second sees an 'objectified motive', which could be 'educating the child in a healthy way that uses technology to support their development'. The third sees the 'desired outcome', which could be 'a well-developed adult who is able to use and think with technology effectively'. Crucially, these different facets will be viewed differently by different components of the activity system.

Although studies which use CHAT can be methodologically diverse, CHAT is well-suited to case study research, as it is intended for research that seeks to understand the "systemic whole of an activity" (Foot, 2014) by examining the often contradictory and complex actions and interactions of components, as is suggested in the analogy above. It is especially well-suited to case study research within Stake's paradigm of socio-constructivist "issue-based" inquiry (1995), as CHAT looks at conflict and contradictions within activity systems as a way to open the door into the system. As a result, CHAT is a strong theoretical framework for research questions which seek to describe interactions and actions within a complex system. For example, the research questions such as "How do the different drives of pedagogists, teachers, parents, students, and the Ontario Ministry of Education directives interact to affect the use of technology at the school?" or "How are decisions about 'appropriate' technology use made?" require a careful analysis of the actors, objects, tools, rules, community of significant others, and division

of labour present in the system. The use of CHAT in the analysis of these questions helps ensure an accurate picture emerges of this complex activity system.

Research Method

The case study methodology used in this study falls within the socio-constructivist paradigm. Epistemologically, this paradigm posits that not only are multiple perspectives and interpretations of the case possible, there is no way to determine conclusively which is the best or most accurate (Stake, 1995). Stress is placed on delivering information that will help the reader to form their own "naturalistic generalizations". Stake (1995) defines these naturalistic generalizations as: "conclusions arrived at through personal engagement in life's affairs or by vicarious experience so well constructed that the person feels as if it happened to themselves" (p. 85). Little time is spent on a summary of codes, with greater attention paid to thick description. Rather than trying to find meaning in an aggregate of instances (a volume or saturation point of coded data), the researcher finds meaning in the particularity of the instances (Stake, 1995). In this way, they are better understood as an "interpreter", providing meaningful detail about the unique complexities of the case in a way that helps the reader to form their own understanding. This method highlights moments of tension or conflict within the case as "illuminative hinges" into understanding the nature of the people and the system under study. This is done less to make a spectacle of failure and more to allow the reader to become familiar with the case by observing how it "struggles against constraints" and "copes with problems" (Stake, 1995, p. 16).

Thick description (collected through observations, document, analysis, and interviews) is used to describe the case so richly that the reader can have a vicarious experience of it. This leads to naturalistic generalization for the reader, which cultivates their understanding, and ultimately induces in them a new way of thinking about the results. In this way, multiple

perspectives are respected; the reader's thinking about the case may be different from the researcher's, and both are based upon an engagement with charged moments from the case. To bring the reader into the case in such a way that they can formulate their own naturalistic generalization, Stake (1995) recommends the use of a vignette to introduce the case and to prepare the reader for "narrative description" (p. 138).

The case study methodology was chosen for two reasons. First, it aligns with the recommendations of the theoretical framework (Foot, 2014) as it supports the study of individuals within a larger system, providing a clear picture of how objects act on goals within a network, especially when there are multiple, overlapping systems with complementary and opposing goals (Laferrière et al., 2013). Second, although the case study approach provides insight first into particularity, it can also be an avenue to generalizability (Stake, 1995), which aligns with the intended goals of the study to ensure that lessons learned are meaningful for other educators and potentially eligible for transfer to other sectors of the Canadian educational landscape.

Chapter 3: Methods

From October 2021 to February 2022, this case study explored the bounded system of the Toronto Waldorf School, using a combination of observation, interview, and document analysis. This section outlines the research method, participants, data collection and analysis procedures, and ethical guidelines used. It also summarizes the author's positionality and other tools for ensuring trustworthiness.

Choice of Research Method

Using an instrumental case study methodology situated within the social constructivist paradigm (Stake, 1995), this research describes the instructional experience at the Toronto Waldorf School, with a focus on understanding the practices and perspectives of a community oriented towards developmentally appropriate technology use, the educational and developmental outcomes of delaying technology integration, and how these students build skills for success in the digital age. The instrumental orientation of the research (in contrast to an intrinsic orientation) means that the case is being used to understand an issue in greater detail. Here, the "perspectives and practices that lead to a technology-deferred learning experience in a developmentally oriented learning context" are the focus of the study, rather than a more open-ended case study of the "bounded system of the Toronto Waldorf School." As such, the issues (research questions) organize the study, rather than the actors (Stake, 1994).

Participants

This research sought to collect data from families who were representative of the case. There was limited exclusionary criteria for participation: families must have children who had attended the school for at least three years and each of the families recruited needed to have multiple children at the school so that they were able to reflect on developmental changes, and

the school's changing technology policies. These families stood as nexus points which guided the recruitment of the other significant body of interview participants: relevant teachers and administrators. This strategy was used to provide a structured approach to exploring the case, ensuring the participants were linked in a meaningful way. Families were chosen from Grades 4, 6, 8, and 10. These grade levels were chosen because they represent a broad swath of the adolescent population at the school. Rather than interview a large number of families, longer interviews with a smaller number of families were chosen so that the analysis could focus on unique stories (in contrast to an aggregate of data).

Recruitment Protocol

Teachers at the grade levels were contacted first for participation in the study. This began a snowball sampling process for families. Participant families were chosen after a preliminary contact with the parents to ensure they understood the aims of the study, consented to participation, and met the criteria for inclusion.

Ethical Guidelines.

This study took place following the ethical guidelines outlined in the Summary Protocol Form submitted to Concordia University's Office of Research Ethics.

Each participant whose contact information was not publicly available was provided with recruitment materials indirectly (either by the Pedagogical Chair, Department Head, or other members of the community). In all cases, contact information was provided for interested participants to reach out to the researcher directly. This mitigated the risk of coercion they might feel by being asked to respond directly to the department head or other member of the community with confirmation or rejection of participation, and all participants remained unaware of who had actually elected to participate in the study. Interested participants received a more

detailed info packet from the researcher via email before being asked to consent to participate in the study. Consent forms were sent to all participants and signed ahead of the interview. At the start of the interview, the researcher confirmed the participant had received a copy of their consent form, provided a brief restatement of the project objective, benefits, risks, and restated the participant's right to withdraw and timeline for doing so.

Data Collection Protocol

Data was collected primarily through semi-structured interviews with parents, teachers, and administrators within the community. Observations were also conducted, providing a rich picture of the technology-deferred learning experience from Grades 4 to 12. Preliminary literature review provided insight into the case and allowed the researcher to develop interview guides and observation rubrics.

Interviews

17 semi-structured interviews were conducted over a period of three months with a variety of participants ranging from administrative and admissions roles (n = 3), class teachers (n = 4), department heads (n = 2), specialist teachers (n = 4), and parents (n = 5).[30] The length of the interviews varied depending on the participant and ranged from 35 minutes to two hours. Participants reflected on topics such as online teaching during the pandemic, tools and technology in the classroom and judging when and how to use them appropriately, 21st century skills, building morality and resilience, and Waldorf education as a developmental approach (see Appendix A). Saturation was achieved when the researcher began to hear similar comments for each of the main topic areas repeated.

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[30] One family interview featured both parents.

Observations

A wide range of classes were observed to gain a rich picture of the case. Math, science, and technology classes were observed with greater frequency, in addition to Main Lessons. These observations were recorded using a rubric (see Appendix B) to capture relevant insights for the study, such as classroom learning objectives, interaction patterns, engagement levels, instances of technology used for teaching and learning, and examples of New Media Literacies and other 21st century competencies such as creativity, problem-solving, critical thinking, and communication and collaboration. The data recorded was qualitative in nature, in keeping with the study's orientation. In accordance with Stake's (1995) recommendations for observation protocols, field notes were taken throughout each class and then the rubric was used after each class to generate a structured reflection, and no audio/visual recordings were used in observations. Saturation was achieved when the observation rubrics began to duplicate findings from previous observations in all major categories.

Data Analysis Protocol

Interviews with parents, teachers, and other members of the Waldorf community were analyzed for themes and description (Humble & Radina, 2019; Braun & Clarke, 2012; Brinkmann, 2013), and observations of classes captured insights into the instructional strategies and outcomes (Stake, 1995). Support for triangulation was also provided through document analysis.

Theoretical Framework for Analysis

This research used Engstrom's third-generation Cultural Historical Activity Theory (CHAT) as its guiding theoretical framework, given its support for understanding technology use in educational contexts (DeVane & Squire, 2012). With its connections to actor-network theory,

CHAT provides a roadmap to understanding how different systems, actors, and objects interact and affect one another (Foot, 2014). This is well-suited to the study's purpose: describing perspectives and practices in developmentally appropriate technology use.

Assuring Credibility and Trustworthiness

As a former student of the school, the researcher was able to operate as an insider, observing with minimal intrusion in the case. This was beneficial in terms of the study's feasibility; however, this role necessitated significant bracketing to ensure trustworthiness (Plano Clark & Creswell, 2015) and a detailed positionality statement was recommended by the committee members to support the work. Throughout the data collection and analysis process, the researcher logged reflections about the case as part of an on-going subjectivity audit for this positionality statement.

Interviews with parents, teachers, administrators, and pedagogists provided a rich opportunity for triangulating data. Observations that took place after the interview offer further opportunity for data triangulation. All interviewees were contacted with requests for member checking to ensure their perspectives were represented accurately. Requests for changes, rephrasing, and deletion were honoured accordingly.

Statement of Positionality

First, a statement *on* positionality. Second, a reflexive subjectivity inventory completed ahead of the data collection that is drawn from Darwin Holmes' (2020) recommendations for novice researchers. Finally, an iterative exercise taken up throughout the data collection and analysis processes that uses Peshkin's (1998) framework for a "subjectivity audit".

On Positionality.

Peshkin (1998) describes subjectivity in research as the "qualities" of a researcher and how those qualities impact the research project, arguing the researcher should be careful to describe and reflect on their subjectivity throughout the research process, rather than waiting until it is over. The goal of this work is to "manage" one's subjectivity, to "preclude it from being unwittingly burdensome" (Peshkin, 1998, p. 20). While I have gamely taken up the recommendation of his subjectivity audit, I offer first a personal statement on positionality. For in any attempt to pinpoint positionality and the subjectivity which governs it, it is crucial to remember the frustrating futility of the task.

Doing Away with Subjectivity.

The pursuit of an authentic and honest inventory of one's own subjectivity is not only a task of herculean proportions, it is also potentially insignificant in the work (Salzman, 2002). What does an inventory of subjectivity (the listing of race, class, and gender) really tell us about the researcher and what types of knowledge they can reliably transmute to the reader? In truth, many researchers frequently misrepresent their own subjectivity, despite their best efforts to clarify it (Salzman, 2002). Can researchers articulate their subjectivity by excising the subjective "parts" of themselves … can we reliably, or "objectively" know our own subjectivity at all (Heshusius, 1994)? Looking at this assertion paradigmatically, attempts to "tame" subjectivity carry traces of positivist science, as they are dependent on the "belief that one knows how to handle things" and "how to keep it under control" (Heshusius, 1994, p. 16) As such, any attempt to manage subjectivity betrays an inherently positivist, objective orientation of the researcher, a paradox which sits unresolved at the heart of subjectivity accounting. In attempt to get away from this paradox, Heshusius (1994) gestures towards a move beyond the objectivity and

subjectivity schism, positioning educational researchers in a mode of participatory consciousness with the sites of study, rather than trying to maintain a subjective/objective distance from them.

Virtuous Subjectivity.

Enough about all the reasons *not* to engage with subjectivity. I agree with Peshkin's reminder that subjectivity be regarded as virtuous as it is "the basis of researchers' making a distinctive contribution" (p. 18). The qualities that constitute what we care about are the very same elements that invite the researcher to enter into research and commit to the work. As such, the goal of this statement of positionality and its resulting inventory is not to neutralize the researcher's subjectivity (Heshusius, 1994), but merely to bring it to light – just as research is fundamentally a process of bringing to light the as-yet-unknown.

I gesture also towards the participatory consciousness of the researcher and *reader*. Just as the researcher and participant co-create meaning in qualitative inquiry, so too is that meaning co-created by the readers of the work. If "inventorying" the various qualities that make up a researcher's positionality will never truly neutralize that position, this process of self-reflection and description invites the reader into a greater position of power with respect to the work. It encourages them to respond in a participatory mode of consciousness themselves, rather than relegating them to the lonely position of outside observer. To you, the reader: Welcome!

Theoretical Alignment with Case Study Research.

My 'position towards positionality' aligns with Stake's (1995) approach to case study research (which I have used as the research method for this study). Working from an explicitly socio-constructivist paradigm, he argues that the researcher is always providing the reader with information so that they can construct their own meaning. Implicit in his approach is the understanding that a researcher's subjectivity is fundamental to meaning-making and

comprehension for the reader. There is no need to hide from that subjectivity or explain it away. Instead, we must bring ourselves and the work into the light, so that our readers may step into the same participatory consciousness with which we have engaged the case.

A Reflexive Inventory

Despite the pitfalls facing any attempt at an effective inventory of one's own subjectivity, this section presents a traditional four-part subjectivity inventory, describing the researcher's philosophical, personal, theoretical lenses, and how they are brought to bear on the research process, and potential influences on the research. It also situates the researcher with respect to the participants and outlines the research-project context and its impact on the research process.

Researcher's Lenses.

For this research process, I'm utilizing a socio-constructivist orientation with respect to epistemology – while data can be concretely observed and recorded, meaning-making is in the eye of the beholder. Theoretically, this research engages with Third Generation Cultural Historical Activity Theory, which treats the actions of actors and objects within activity system. In this sense, I am attending to the power of "teacher" on the activity of class as much as I am to the influence of "blackboard".

Potential Influences.

Despite studying a low-tech environment, I'm anything but a neo-Luddite myself. As much as I have encountered the negative uses of learning technologies, I have truly experienced the positive dimension it can bring to a life. I want to help clarify its positive uses and contribute in any way I can to appropriate exposure in the classroom.

A significant influence on the desire to start this research was my work as an English as a Second Language teacher in China. The joke there is that kids are study robots – at times it felt

true. I noticed challenges to the students' physical and socio-emotional development early on, and the more I got to know them, the more I felt their educational experience, so oriented towards test scores, was sucking something deeply human out of them.

After my first year there, I was chosen to travel to Shanghai and train on the newest curriculum offering for teens. It was here that I got my first taste of charismatic technology. The course came with an in-class workbook, but it also came with a homework app and a test-taking app – no more grading tests manually! As the project manager for this curriculum integration in my home city, I quickly realized the flickering promise of these apps. The students performed "speed runs" of the homework, getting the answers wrong in quick succession for their completion mark and then moving on, with no concept retention in class. The test-taking app required constant updating on the 15+ iPads; updates which came in at unexpected intervals and were somehow discovered minutes before a test, even when I'd been sure to update them during my free period earlier in the week. And the WiFi! Somehow it was never working right when we needed it, or it was out on one student's iPad inexplicably. I don't think we ever took a test smoothly.

Screen-based learning dominated all classes and it's not to suggest that there weren't positive moments. Being able to show videos that provided a path to complex ideas the students' level of English literacy could not yet meet were particularly strong outcomes. More often than not however, using screens in the classroom felt like an expensive joke. For example, we were routinely asked to engage in the futile practice of getting four-year-old children to trace letters of the alphabet … with a finger … on a touchscreen. You can imagine how well that works, especially when they reach out and place their other hand on the screen in an effort to steady their balance, given the fact that they are standing on chairs … because no one in their right mind

would hang a TV screen at a four-year old's chest height. At every age, despite the money and time and effort we were spending to mediate their education through expensive screens, they were at their best when we played in-person games. Performance was high, language production was high, and most importantly, confidence was high.

So many of the conversations I have had since I've returned to Canada, not just with parents and teachers, but with friends who work in post-secondary or in IT, highlight the negative effects of pushing learning expectations earlier and earlier onto students, depriving them of the time they need to develop themselves, and losing their connection with reading, with fine arts, with curiosity, with imagination – and with complex problem solving and critical thinking, as a result.

Position.

In this case, I sit at the intersection of insider/outsider roles, a two-faced Janus looking out and looking in. Having attended this Waldorf school as a child before moving to public school, and then having worked there in a limited capacity as an adult, I carry insider knowledge about the case from my personal interactions with it in the past. Given the distance from the case, especially as its faculty and practice have changed since my time there, I am not so affiliated with it as to be rightly considered a participant myself. In sum, I possess a level of understanding of the case that is greater than that of an outsider, but I have limited affiliation with the case which might constrain my analysis.

Ways In Which the Research-Project Context Have Been Influenced by the Above Considerations.

These considerations affect the research-project insofar as they created the conditions for its being … a great deal! While engaging in the collection and analysis phases, I have tried to

document the feelings that emerged through reflective practice. These reflections are summarized in the subjectivity audit below.

Subjectivity Audit

Given that the search for subjectivity remains so fraught and elusive, it is important to continue to revisit it throughout the research process. This section uses Peshkin's (1998) recommendation to attend to the "the warm and the cool spots" of positive and negative emotions throughout the research process (p. 18). Throughout the research process, I took time to document my gut and emotional responses to the work.

Education.

I've had the supreme good fortune to attend a number of great schools. As a result, I value education and believe that it is a fundamental piece of the puzzle in most societal solutions. Despite having attended an independent school for part of my life, I believe high-quality public education is constitutive of a healthy and effective democracy

Translation.

I'm interested in looking at alternative methods for improving public education. Critical studies of Waldorf education are few and far between (Code, 2020; Dahlin, 2017), in part because it is inaccessible to educational practitioners because of the internal language and style of its writing (Dahlin, 2017; Gidley, 2010). For this reason, conversations between Waldorf schools and pedagogical practices have been limited. I'm also hoping to bring educational technology into greater conversation with elements of developmental psychology. Much of EdTech training is oriented towards andragogy, yet the field is increasingly implicated in pedagogy solutions for public and private schools. I'm trying to use my insider/outsider status to contribute to these translation efforts and bring the fields into dialogue.

Community.

The Toronto Waldorf School holds a number of very good memories for me. When I walked into the building each day for observations and interviews, I could feel a rise of good feeling in myself. Consequently, in moments where I could see the teachers or parents express a criticism, I felt an emotional response to smooth out or dispel the tension. The *emphasis* on tension in the research methodology and theoretical framework that I used were particularly supportive on this front: both ask the researcher to stare directly at the moments of conflict that are present in the case. I was continually pushed by my research process to see and describe those moments clearly; despite my first emotional response, I could not shy away from them.

Ethics.

I feel that this research needs to be done and it comes directly out of my lived experience of the problem. In this way, I occupy an ethical orientation towards the work, believing that the findings have potential to help others. I am trying to describe a link between Waldorf education and healthy development and 21st century competencies because I feel like we need more support in this area if we are to support students. As a result, I found myself drawn to moments in the research process where participants highlighted the same ethical concerns.

Chapter 4: Findings

This section summarizes the findings of the study, combining data from observations, interviews, and document analysis to paint a rich picture of the case. In keeping with Stake's (1995) recommendations for case study research, it opens with a vignette and then addresses each of the research questions in turn (Stake, 1994).

Setting The Scene: A Vignette

At the Toronto Waldorf School, every day begins with a nature walk. Families are encouraged to drop their children off a short distance from the school, and they walk a gravel path from the parking lot, down into the river valley, and up again to reach the front doors of the school.

I'm joining the students on the walk today and the pull of the natural world on either side of the path is irresistible. I watch students pause to investigate cocoons in the branches, birds' nests, and mud puddles. Many of them stop at the bridge to peer over into the river – although it has been many years since I was a student here myself, I do feel a need to stop for a moment and look out at the twisting of the river for ducks or turtles that might be lurking underneath the bridge. A teacher speeds past me, jogging briskly in winter boots up to the top of the hill.

The school rises back into view as I ascend the hill. It's architecturally unique (See artifact), and every time I've taken an Uber right up to the front door, the driver has remarked some variation on this theme: "I've always wondered what this school was like". Just a portion of it is visible from the major street on the other side of the river valley, providing the property a sense of privacy and protection, but also affording it a sense of mystery to those driving past.

I head into the building and register with the school nurse. COVID protocols have changed much of the school's day to day functioning, but I feel this nowhere more strongly than

in the entryway. Usually busy with students and parents, community events, and student projects, it's mostly empty this year. Still, there's artwork on the walls behind the nurse's desk: a 12 foot mural of a winter scene, illustrated with glyphs from the Kinoomaagewakog (Petroglyphs Provincial Park). I follow the stairs up into the beating heart of the school: the Forum. Observed from above, like a clock-face, the classrooms follow the needles journey from eight to four, with a large stage occupying the space from five to six at the base. It's immense, ceilings as tall as the space is wide, with natural light pouring through. Just like the room itself, the ceiling is circular, a series of wooden beams stacked horizontally at precise angles. During community festivities, school plays, and graduation ceremonies, this room is packed: for now, it is quiet, echoing with the faint sounds of singing, verses, and other class time activities.

If I could peak into the Grade 4 classroom, sight unseen, I would be met with the quiet reverence of their attention. They're seated at their desks, beeswax warming in their hands. Most of the students are looking up towards the front of the classroom where their teacher is just getting to the good part in the Norse myth they're hearing that day. A few students look elsewhere, fidgeting with rulers or pencils. One sits perched on a one legged stool, their chair pushed off the side up against the wall. It's a tight fit – this classroom is chock full of decoration, warm and inviting. The ceilings of the room are high; the walls are painted in a muted technique called Lazur, in which paint is applied in multiple light washes, giving the room a softly colourful glow. The chairs and desks are made of wood, with runic interpretations of each student's name taped to the back of each to mirror the Norse Mythology they are studying this month.

There's a breeze blowing in through the open window and it catches on a silk cloth draped over a music stand at the front of the room. Above it, on a blackboard stretched across the

room, is a chalk drawing of Yggdrasil, the tree of life. It's detailed, demonstrating a level of skill in chalk drawing that is almost certainly taught. Hand-knitted recorder cases hang on hooks underneath it.

At the back of the room, handmade brooms sit next to the watercolour painting cabinet, a practice which students engage in regularly. The paints are mixed with vibrant pigments of red, yellow, and blue. The cool blue pigment has a particularly pungent smell to it. Along the back wall, the teacher has posted up handwritten 'red words' – a category of words that break the phonics rules that the students have been taught. Students can retrieve the word from its grouping (arranged by first letter) and take it to their desk to practice spelling it as needed.

The overhead lights are off. A candle flickers on a small desk next to the teacher.

The students gasp as the teacher plucks Odin's eye from its socket – the price paid at the well of Nemur for all the wisdom of the world. There's no visual support of this story in sight, no video or slideshow for the students to *see* it, but based on the reaction from the students, she might as well have plucked it out of thin air in front of them. *They see it* and the excitement is palpable. I notice the boy at the front of the classroom who was playing with his ruler has whipped around in his chair, carefully assessing his classmates to make sure they've caught this gory detail. Gleeful and satisfied, he turns back around. I'd assumed he wasn't listening.

Moving on, I might walk a few paces to the Grade 6 classroom. Casting my gaze upward for a moment, I take in the scope of the Forum, the high ceiling, the teardrop shaped window at the apex. It feels more like a cathedral than a school. Watercolour paintings and other examples of student art are posted up around the classrooms. Musical instruments are stacked, somewhat haphazardly, outside of the Grade 6 classroom, and I wind my way around them as I drift in.

They sit engaged in a group review of financial math, calculating percentages and annualized returns back and forth without calculators under the teacher's careful supervision. The students are active, eager to put their hands up and participate. Just two grades apart, the feeling in this room is different than the last. The room is minimalist by comparison. A space organized for a group of increasingly unwieldy young adults. There is an authority here, a strictness – one motivated perhaps by the group, that feeling that if there isn't, they will start to come apart at the seams, pulled in all directions by the increasing changes in their developing bodies.

The signs of adolescence are here in a way they were not yet present in Grade 4 – feet too big for bodies, limbs stretched out like funhouse mirrors, many of the boys shorter than the girls who look a year or two older. Here, it's clear that each of the wooden desks has been sized individually to suit the student. Some are the size of the desks in the Grade 4 classroom, but others are tall enough I suspect I could sit comfortably.

The class shifts from their maths review to a more free-form discussion of financial concepts. The students ask questions that surprise me, such as "What happens when everyone takes their money out of the bank?", "How do countries get in debt? Can you lose a city if you go into debt building it?", and "I want to learn how to do taxes" (the teacher acknowledges they'll cover at least that last one the following day). They reference PayPal and Cryptocurrencies in a way that highlights just how present in the modern world they really are. They settle into their bookwork, carefully transcribing what they've reviewed into their Main Lesson books with triangular Lyra pencils and calligraphy pens – and varying degrees of neatness in their cursive writing. In addition to the text, each page features an illustration of some

sort and a colourful border around the edge. As I depart, the teacher admonishes off-task students gently but firmly on the reality of natural consequence: “You’re making your choices now.”

Two classrooms down and not a screen in sight.

Walking to the Grade 8 classroom puts me past the halfway point of this semi-circle around the forum. The stage dominates the view from this angle, just as the Grade 8 play dominates much of the year –a culminating performance attended by much of the community. Grade 8 is a transition year, a big one, even in a school where the Grade 9 classroom is just another door away. This is due, in no small part, to the significant pedagogical change that will occur between Grade 8 and 9 – the shift from the same class teacher they’ve had since Grade 1 to a team of high school advisors who will take them through to Grade 12.

I can hear this class before I even get to the door, a small sign encouraging me to “Smile” as I enter. They are boisterous and confident, kings and queens of the Lower School kingdom. At this age, their connection to each other, to the social whirl and constantly ebbing and flowing drama of friendships, crushes, and cliques, is paramount. The negotiation of what’s teasing and what’s outright meanness is so painfully alive here. The space between them is one of rich socio-emotional negotiation – and the teacher is having a hard time getting a word in edgewise. She’s chosen to lean into this and let them present the lesson to each other, assigning topics in Canadian History such as: unsafe working conditions for immigrants, conservation and environmental sustainability, women in early Canadian history, revolution, and political warfare by economic means.

The first presentation gets going and the students pass around a visual support for the presentation: a hand drawn map of “Rupert’s Land”. The students present with varying degrees of confidence – some read dutifully from their notes, while one recites, seemingly by memory, a

five-minute sermon on the writings of historical figures who journeyed to Canada through the underground railroad. One student claims he is not ready to present and receives a rousing show of encouragement from his peers. He gets handwritten notes out of his bag and delivers an off-the-cuff presentation that betrays a solid understanding of not just the material, but its connection to other topics.

It is during these presentations that I catch my first glimpse of a screen – if by proxy. One student is presenting with typed-up notes.

The group is practicing notetaking with quick handwritten flourishes but they interrupt each other to concept-check with the kind of abandon that reminds me how little self-regulation exists at this stage of development. It's almost as though the thought is already spoken aloud before they become aware it has even been thought. Artifacts of the presentations litter the classroom. Two chess boards sit pushed to the side of the room, games evidently in progress.

Still no phones.

I walk past the Grade 10 classroom, which has been absorbed by the Grade 9 class for the small-group cohort scheduling they're using during COVID. I'll see the Grade 10s later, as they are tucked away in one of the more unique rooms this school has to offer.

The Grade 12 class is in full swing, with student presentations that contrast sharply with the dynamic of the Grade 8 class. While the 8s were barely contained, practically jumping out of their seats with questions and comments and clarifications, the 12s are measured and restrained. Two students stand at the front of the room, relaxed in the midst of presenting to the group on the Appendices of *The Handmaid's Tale*. Their peers regard them carefully, eyes up and engaged in their presentation. I spot a few laptops closed on desks, with Yondr pouches present on most. A few girls knitting white squares for a quilt while they watch the presentations. Given the way

some have strewn their belongings across the desks, it's clear they feel it's *their* space and their items are safe (the transience of my own public-school experience contrasts sharply with this sense of security).

While there is a projector screen and an AirPlay projector bolted into the ceiling, these students have no PowerPoint presentation. They have a laptop on the desk in front of them, as well as a copy of the book in hand and they speak clearly and mostly from memory, in confident tones about this challenging section that I have no memory of even reading when I studied *The Handmaid's Tale*. They're supporting this presentation with significant external research, fleshing out many of the ironies and implications of Atwood's historical allusions, and speaking to the real-life theocracies and uprisings that inspired her work. As the presentation comes to a close, it transitions steadily into a larger class discussion, one which is respectful but energetic – these students hold a level of personal opinion about the work they've encountered. They make connections with previous studies in mythology, poetry, Orwell's *1984,* and display a level of maturity towards difficult themes raised (contraception, genocide, rape, death, infertility, and polygamy), holding respectful space for each other's responses to the work. The discussion concludes on the subject of moral relativism. One student comments: "You cannot bring the past to the present". Another counters: "We must not censure history and other cultures but we still need to think about the effects of their actions and to consider if we would want that to happen again".

I head downstairs towards the labs. Grade 10 is here in the Physics lab, a room which feels sort of like walking inside the mind of a mad scientist. It is packed full of strange objects, a time capsule of science education at the school: Arduino textbooks and kits, Snap Circuits, an Oscilloscope, boxes full of LEDs and wires, robotics gear, toolboxes crammed with all manner

of knives, rulers, and glue guns. In the storage warren off of the lab there are two 3D printers, microscopes, and shelves of old audio equipment.

The students are working at lab benches, two to a bench, in varying stages of effortful work towards their project for this Technology Design Main Lesson – transitioning from a 2D to a 3D model of a house. Some of the students are still cutting out walls from foam core but most are in the decorating phase, a wide variety of materials shaping their unique house. Walking from table to table, I'm struck by the diversity present in the work: cute cottages, Zen inspired studios, Bridle Path-esque mansions, and fusion multi-level experiences. Some have landscaping and greenery out front; some have focused more on the aesthetic interiors such as wall painting and model furniture. I spot a house with far less decoration than any of the others – instead, a mess of wires emerges from it. Later in the week, I'll watch the student who built what is actually a fully functioning miniature elevator puzzle over the math that maps out its acceleration with a friend on the whiteboard.

There is a real mixture of approaches in this group. Some have clearly stuck to their plan in 2D and articulated it with exacting care. Others are choosing a more playful approach, trying out salvaged materials and experimenting with how they can fit together. I notice a real difference in self-regulation and focus here too – they sit squarely between the eights and 12s, some caught up in the impulse chatter of the 8s and some readily able to settle into an almost monkish quietude with their task. While they're all the same age, I realize they are not all growing their cognitive capacities at the same pace: their higher order skills like focus and sustained attention are developing at different speeds.

A poster at the front of the class reads: "We need, in every community, a group of angelic troublemakers".

The teacher shifts amiably from student to student with no discernible structure or time limit, checking in and asking questions that vary widely depending on where the student is at. He's resistant to giving easy answers to the questions they ask and seems less focused on getting the houses built in a timely manner than zeroing in on the unique problems faced by each builder and offering glimmers of guidance as they work through solving them. One student is trying to figure out a contemporary roof design with several different geometric shapes needed and struggling to translate the 2D reference on her phone into 3D space. The teacher recommends "Goldilocksing", playing with different pieces of paper before cutting into the foam board, and she gamely takes up this transmedia moment, working through the design process with the teacher. There's a level of discomfort and uncertainty in her face, and it's echoed by some of the other students: it's not easy to work through a solution when there is no clear procedure in place, and because they've all developed such unique designs, it's impossible to copy the procedure of a peer. Nevertheless, that doesn't stop them from helping each other, making suggestions or recommendations, or passing equipment down. It's evident from the way this class plays out that the final product is incidental: the lesson is the process, especially the kind of problem-solving that it cultivates.

It's lunch time but the students haven't moved, nor has the teacher acknowledged the time. There is no intrusion of a buzzer from on high as I slip out the back door of the lab and head outside towards the back property. It's quiet for the time being, just me and the trees. Leaves crunch softly under my feet as I walk. Carefully arranged piles of mid-size sticks and logs form structures towards the back of the forest, while man-made wooden play structures dominate the front. The sense I'm left with is that of a playground melting at the edges into the

forest. There is no concrete and no plastic, and the materials present mirror the materials available in the forest.

As I head back from the ravine, I can hear the shrieks of happy kids as they trickle out into the forest for lunch recess. It's only a few at first, but more and more arrive as they finish their lunch. The dynamics of the class groups - especially the sounds - are like packs of animals, blending together the way that birds swoop in over a feeder. Peals of shouts and squeaks echo through the forest. They're decked out in gear suited to the temperature and ready to play.

Standing out in the forested area behind the school, I meet with one teacher over his recess duties. We're interrupted frequently by the students, sometimes with requests to climb the trees, sometimes just because they want to ask him a question. Rarely does he actively police or discipline. There are checks to make sure no one is hurt, but risky play at this school is encouraged at all levels and certainly possible in this natural environment. At one point he acknowledges to me: "Whether we are right or wrong, we have a certain picture for what it is to be a healthy human being".

Heading back towards the building, I follow the curve of the school to the right and out towards the field, where the New Wing (though it has not been new for many years) juts out. I cut across the field and head over to the gardens to take the back doors back into the school.

I pass by the Handwork and Woodwork rooms first. Peering into each room might reveal a series of projects of increasing complexity. In Handwork, Grade 1 students could knit a potholder, while Grade 4 crochets a pencil case, Grade 6 stitch puppets, and Grade 8 brings with it the first experience of the time-saving might of the mechanical sewing machine. Correspondingly, Woodwork classes typically begin with whittling a small mouse, eventually ending with the student building a three-legged stool.

Continuing down the hallway of the New Wing, I peak into the Art Room. High school students, back in class after lunch, are reviewing a PowerPoint of Magritte's paintings on the TV screen affixed to the wall as the teacher introduces this period in art history. Examples of student art are posted around the room and throughout the school, ranging from water colour to acrylic to black and white pencil sketches. The faint sounds of tuning grow louder as I walk past the gym and the Eurythmy room, two complementary forces for physical education that are required throughout the students' time here. The orchestra kicks into gear in the Music room, strings and woodwinds rising and falling under the direction of the conductor.

I head back towards the original round of the school, passing play bills posted from years of Grade 12 plays, and a figure-eight made out of post-cards from students at other Waldorf schools around the world. Across from it, the graduating class photos of each Grade 12 group since the school opened over 50 years ago. There's a poster affixed to the bulletin board as I turn in: "We are a SCREEN AWARE early childhood practice". It jolts me into realizing that the screen I saw in the Art Room is the first I've seen today.

Heading up the stairs once more, I keep going up instead of exiting into the Forum and emerge out onto the Mezzanine, a third floor which sits above the Forum, overlooking it. Walking around the circle, I pass the Library, and peek into the Computer Lab. Next to the ICT policy posted at the front of the door, there's a poster that says: "The internet could be the pinnacle of spirituality. An out of body experience based on the interconnectedness of all beings, with a focus on free education and information".

I stand out on the mezzanine, overlooking the Forum – the high school vocal class warming up, voices rising up to meet me, supported by the acoustics carefully engineered for this space. Even the smallest voices have a way of echoing and bouncing around. It's a sphere of

amplification in many respects. The sound, yes but perhaps more importantly: this space invites you to be a greater version of yourself. When beautiful, grand architecture houses us, it has a way of inviting us to be great, too.

My family sold the house I grew up in and the one after that, too. There are few places in the world that evoke that kind of familiarity for me anymore. Despite having left the school at the age of 14, this one is the strongest, without a doubt. Sometimes when I dream, it's set in this space where I am standing right now. I'm not sure if that means something, but it's part of what I'm here to find out. I mention later to one of the teachers that the school is an easy place to go to in a dream because there is so much emotion attached to it. Her response:

> That's intentional, you know? In the Lower School, we're really working from the feeling. The stories are so important because we're meeting the development of the students through their feeling life - if you think back to when you were in Grade 2, or Grade 3 or Grade 4, what do you think about? Do you think about, "Oh, I learned about x day in Roman History" or things like that? Like I don't even remember learning how to read. But I remember the feeling of like this one reader that I loved and sitting in my classroom with the scratchy carpet. We're working from a place of "how they are feeling with things". And you can't get that through a screen. There's a difference between if I were to read you a story, even face to face, versus me *telling* you a story. It's imbued with life and feeling. It's the same thing if you're in a Zoom meeting versus talking to someone, that human element, some sort of connection, some sort of feeling of a back and forth. You can't get that from a screen.

Research Questions

After outlining the participants' links to Waldorf education and the organizational structure and activity system present in the case, this section answers the research questions in turn.

1. What does a community oriented towards appropriate technology use look like?
2. How has this school approached recent periods of compulsory online learning?
3. How do the different drives of teachers, parents, students, pedagogists, and the Ontario Ministry of Education interact to affect technology for teaching and learning at the school?
4. How are decisions about 'appropriate' technology use made?
5. What objectives are met by delaying technology use?
6. How does a 'developmentally oriented instructional experience' facilitate 21st century skill building and digital literacy development in students?

A Note on Holism and Reductionism

Analysis of interviews revealed that a number of participants' epistemological orientations swing in favour of 'holism' in contrast to an atomistic framework. In one discussion of healthy development, the participant noted: "Imagine we said, we're gonna feed just the muscles, we're gonna feed just the bones, and then we'll put them together. What causes the bones to get stronger is the tension because of the muscles. It's how they work together that matters." Yet this analysis persists in discussing physical, cognitive, and socio-emotional development as distinct categories. Why? In accordance with the task of translation set out for this work, the categorical distinction adds to the overall level of understanding and naturalistic generalization possible for a broad audience. It is also aligned with the theoretical program of

developmentally appropriate practice and technology use, which this case study is examining alongside Waldorf education.

Why Waldorf?

Participants were asked to describe how they came to be at the Toronto Waldorf School (TWS), in an effort to understand their original motivation for school choice. For teachers and administrators, common reasons included: a personal connection to the school (such as knowing someone who worked there or hearing about it from a friend), dissatisfaction with public school teaching methods and outcomes, interest in anthroposophy, and a desire to work within an egalitarian organizational structure. Notably, all of the participants who work at the school also sent their kids there for schooling.

Parents also shared a personal connection to the school, and dissatisfaction with their experience of public school. Some felt that their children were unhappy, disengaged, and struggling in public school, that public school practice was not developmentally appropriate and was having a negative effect on their children, and that it lacked 'heart'. Most participants had their children in public school at one point and had pulled them out as a result of some combination of the issues outlined. Some participants also expressed concern around the level of technology/screens present in public school (based on their study background or personal research) and felt that the teachers did not have control over the use of cellphones in class. For some parents, TWS helped scale back the digital device exposure in their own home as they found it easier to impose boundaries/restrictions due to the community of shared values in the parent body at the Waldorf school. For one mother I interviewed, concern around technology use was what first put Waldorf education on her radar. After watching her son "turn into a zombie" when watching TV, she began to explore alternative education and parenting strategies. All

expressed a desire for their child to experience a balanced education: they sought a play-based, experiential, and active learning pedagogy attuned to healthy development (especially socio-emotional wellness, mental health, and character-building curriculum) alongside strong academic foundations.

Not Without Risk.

Participants acknowledged some judgement from others in choosing to send their kids to TWS. These concerns were centered around their kids 'falling behind' because of the different pace of academics. Some also expressed criticism that others felt they had abandoned public education in favour of private education. They acknowledged that engaging with an alternative pedagogical system was 'not without risk', especially for first-generation immigrants to Canada. The school has experienced a significant demographic shift in the new families that are interested in the school, a group that is now predominantly Asian (Chinese/Indian) background families who are seeking a different type of education for their children than the rigorous, structured, academic style of education they experienced in their youth.[31]

Situating The System (CHAT)

In keeping with the theoretical framework, a diagram is outlined to help visualize the connections between actors, objects, and rules and tools in the community.

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[31] Zhao and Gearin (2016) contextualize this well: "East Asian education systems recognized that centralized decision-making, test-driven accountability, and narrow core curricula were barriers to improving their education systems because they created a variety of unintended consequences. The most studied of these unintended consequences include the corrosive emotional atmosphere in schools, large shadow education systems, the normalization of corruption, and a focusing on testing instead of richer, more authentic learning (p.125).

Figure 1. *School and home activity systems*

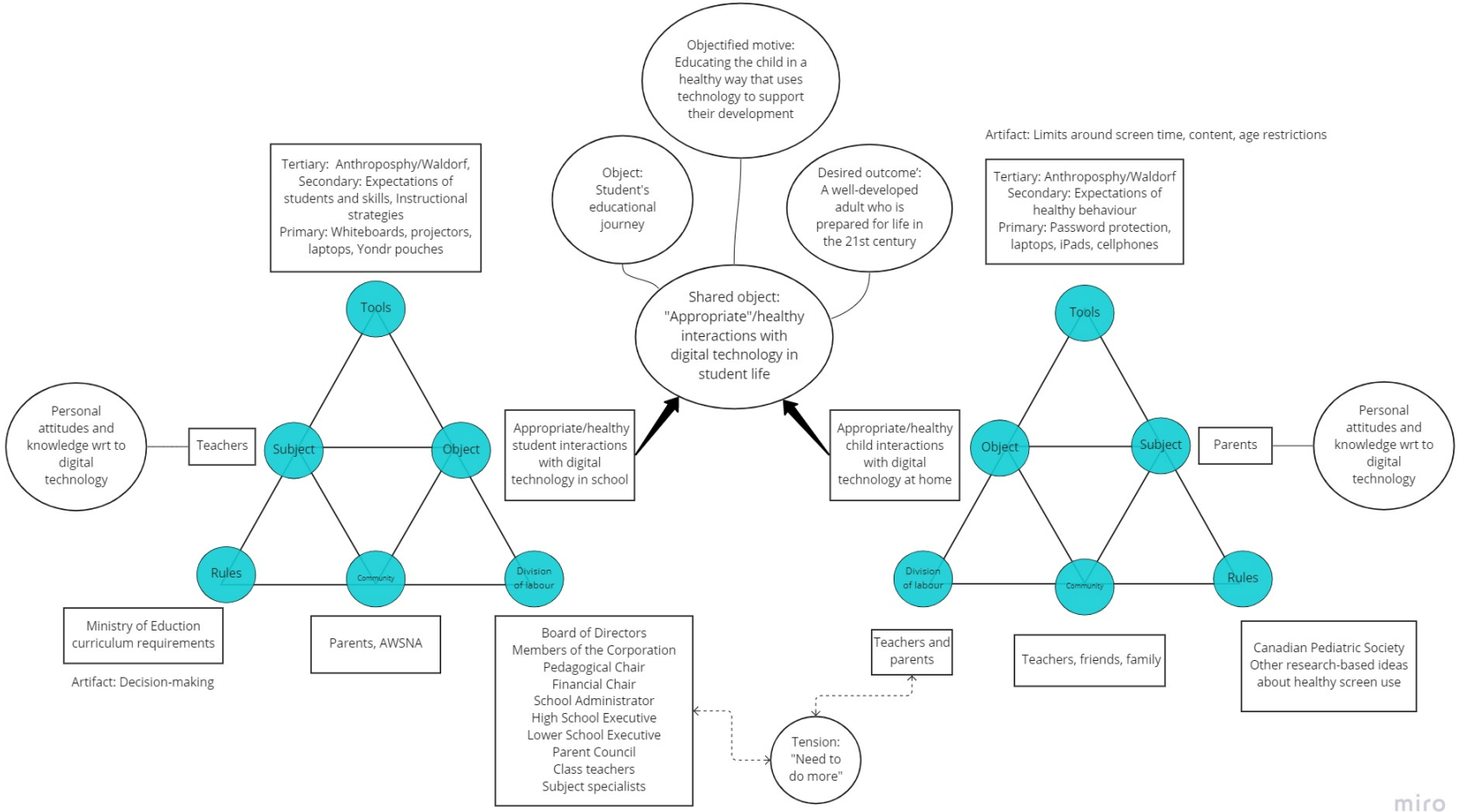

Figure 1: In this diagram, two different activity systems are represented: the school life and the home life of the child.

In each activity system, there is an object: the "appropriate or healthy student interaction with digital technology in school/home.[32] While each activity system is distinct, analysis of the interviews revealed that the subjects in both activity systems are concerned about the pursuit of the object within the other activity system: in short, that parents are concerned about the presence of digital technologies in the school, that teachers are concerned about them in the home, and that both have mechanisms for action upon each other. As a result, there is a shared object between the school and home activity system, which is understood to be "Appropriate/healthy interactions with digital technology in the student's life".

It is clear that some (though not all) parents are *part* of the school's organizational structure and contribute directly to its decision-making processes. Based on the analysis of effect from these parents, this diagram positions some parents within the community of significant others and part of the division of labour at the school, as they are working towards the same object as the school's activity system: "appropriate or healthy student interaction with digital technology in school". In much the same way, interview analysis revealed that parents seek support and knowledge from teachers to determine actions in the home life of the student, and so teachers must be categorized as part of the community of significant others for these parents.

To summarize: while parents (as subjects of the "home life" of the child) generate their own activity system with respect to developmentally appropriate technology practices, they are also playing a role within the school's activity system, just as the teachers are playing a secondary role in the community of significant others in the home.

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[32] Note that one could easily represent the overall goals of each activity system as much broader, and even the actors as different, but with respect to this study's lens of developmentally appropriate practices and technology, this is the most pointed articulation of each.

The Organizational Structure of TWS

The Toronto Waldorf school is made up of a teaching faculty, an administrative body, a Board of Directors, and Members of the Corporation. Parents also play a role in the activity of the school, either as members of the Board, the Corporation, or the Parent Council, and as Class Parents. While observing the Calgary Waldorf School on a Peer Observation committee for AWSNA accreditation, faculty members were impressed by the school's organizational model and brought it to TWS.

Faculty.

The Faculty is made up of three different divisions: Early Childhood (Pre-K and Kindergarten programming)[33], Lower School (Grades 1-8), and High School (Grades 9-12). Within the Lower School, there are Class Teachers (who take a group from Grade 1 through 8), and there are Specialist teachers (who teach subject specific lessons, such as Music, French, and Gym). One or two teachers work as the Lower School Chair, a leadership role in the faculty. Within the High School, there are Advisors (who work in teams of two or three to mentor a group from Grade 9 through 12), and Specialist teachers, as with Lower School. While these are understood as distinct faculties, there is increasing overlap of Specialist teacher roles, with some HS specialist teachers teaching in the middle school years. One or two teachers act as High School Chair, paralleling the executive position found in the Lower School. There is also an overarching position of Faculty Chair.

Teachers form the Faculty Council, which acts as an executive body that makes pedagogical decisions and communicates with other elements of the activity system. All Chairs

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[33] ECE is beyond the scope of this inquiry and for expediency purposes has not been given a full treatment in this organizational analysis

must sit as part of the Faculty Council (Early Childhood, Lower School, High School, and Faculty Chair) and any other teacher who wants to be can also be a member of it

Administrators.

There are two major executive positions within the school's administrative body: Director of Finance & Administration and Pedagogical Chair. They are supported by the Admissions, Human Resources & Office Manager, the High School Administration & Alumni/ae Coordinator, and the Technical Services Coordinator. Notably, the organizational model calls for a three-part administrative team: Pedagogical Administrator, Financial Administrator, School Administrator but at TWS, they have not yet found someone who can fulfill the School Administrator role, so the Pedagogical Chair has been doing "double duty for years".

Board of Directors.

The Board is made up of a Chair, two Vice-Chairs, a Secretary, and a Treasurer. These positions are typically filled by parents at the school or members of the community. The Board's mandate is towards the fiduciary well-being of the school and it works to support the mission of the school, be that financially or otherwise.

Members of the Corporation.

These are similar to shareholders or stakeholders in a not-for-profit context and the roles are open to parents, faculty, staff. They typically vote on items outside of the Board's mandate, such as financial statements or voting in a new Board.

Parent Body.

Parents participate in the running of the school in two other ways: as Class Parents (working in teams of two or more as volunteers to support the extracurricular activities, fundraising, and other support structures for each grade, rotating each year), and as members of

the Parent Council. This council meets every month and interacts with Class Parents and members of the parent body to communicate and address suggestions or concerns.

Bi-lateral information flow.

Notably, these councils do not operate in isolation. For example, the Director of Finance & Administration and Pedagogical Chair are also members of the Board. Members of the community are encouraged to bring presentations directly to the Board regarding concerns at the school. Vice-Chairs swap attendance at the weekly meetings of the Faculty Council. Leaders of Parent Council meet frequently with the Administration. Participants highlighted that while there are clear formal channels for this kind of bi-lateral communication, much of the communication also takes place through informal channels first – student pickups, extracurricular activities, festivals – and transitions into formal channels after gaining traction. In this way, conversations or interactions between members of the activity system which take place outside of formal meetings can generate actionable information which is brought to bear in these more formal contexts

What Does a Community Oriented Towards Developmentally Appropriate Technology Use Look Like?

> *My son knew he wanted to be a computer coder from when he was in Grade 2 or 3. So naturally, one of my thoughts when I was coming to Waldorf was "am I actually making a decision that's going to change the course of his future? That I'm now pulling him out of an environment [public school] where he can get more of this?" And it has made only a positive difference.*

A mother of two neurodivergent children found that the "therapeutic way Waldorf teaches" supported her children in ways that public school could not. While she couldn't identify

what was wrong with the traditional approach, she knew her kids weren't being guided to learn and that they weren't receiving enough attention, despite the accommodations afforded by their IEPs. She told me that, at Waldorf:

> The way they look at each kid, I mean, from the smallest gesture of greeting them in the morning to you know, that was like making him feel like the king. [The teacher] would recognize what he was good at and really pump him up. He needed that extra encouragement, not sitting at the desk doing paperwork at that age. He didn't have a single day of that type of experience at Waldorf where the teachers were saying to me, "No, no, no, he won't do his work". They didn't even see that side of him. And he was like that for two years in public school".

This emphasis on social learning, on socio-emotional well-being in the classroom, and on attention to the needs of each individual based on their context can allow for transformation in students. Despite paying for years of occupational therapy, at Waldorf: "They're not calling it therapy …They're just calling it school." For this family, a school built on developmentally oriented practice "changed everything". She acknowledged that at public school: "Kids like that just fall through the cracks. Because the focus isn't on the development of this person, its "I have to make sure I've covered this information, or I'm going to get in trouble".

While this is a unique and family-specific story, the observations made underscore many of the themes that emerged in conversation with parents and teachers at the school: that a slower approach to technology is not seen as undercutting later technological skill, that a student's motivation for learning is improved by teacher's concern for their affective engagement, and that the school day must attend directly to the developmental needs of the students if it is to serve their learning journey effectively.

Developmentally Appropriate Practice.

Observation and interview data tracked a persistent "developmental" orientation in the perspectives and practices present at TWS. The lessons were multidisciplinary, multisensory, emotionally engaging, and attentive to the needs of individuals as students experienced the broad range of horizontal and vertical curriculum typical of Waldorf pedagogy. One participant explained to me: "Waldorf education is holistic. So we're looking for as full a development of every human capacity as possible." The curriculum is seen as a vehicle for the child to become a fully developed human being: "Whether it is Eurythmy or math, the person coming out of that classroom should be a better human being, not just a more knowledgeable one". Curriculum is understood as a mediating tool and interactions between the teacher and the student (understood with respect to each's context, affect, and interest) are all facilitated by this full day curricular experience towards the end goal of "being a better person".

Emotional well-being and a developing self-concept are key in the Waldorf classroom. Practices and perspectives revealed socio-emotional engagement is considered a condition of learning, not an added bonus:

> I spend more time worried about their social-emotional wellbeing than their academic wellbeing. And it's not that I don't think that their academic wellbeing is important. But I do know that without tending to their social-emotional wellbeing, they're not learning. And so I really strongly believe that most of my energy needs to go into their social emotional wellbeing to free up the resources that they need for education. And if I spend all of my time just to unburden them, then they learn it like this [snaps fingers]. And I don't have to repeat it 16 times [laughs].

Participants highlighted that "the heart of the education at the school is the social curriculum", that *relationships* sit at the core of the pedagogical practice. And not just the relationship between teacher and student, but relationships between students. Because the students stay with the same group (there is only one class per grade), the health of the class is a serious consideration for the teacher. Conflicts and disputes are regarded not as behavioural challenges to be swiftly eliminated by the teacher, but as a natural site for social growth in which young people learn how to be together and learn skills in resolution and restitution.

Time For Development.

During my time at the school, I noticed class time was freely allocated away from academic or traditional classroom activities in favor of community activities, physical exercise and games, and socio-emotional check-ins that focus on developing relationships, emotional intelligence, and morality.

Morning Rhythms.

Each morning, the Grade 12 class meets outside for 15 minutes with their advisors. They typically engage in a physical warm up, the recitation of a verse or song as a group and discuss any relevant administrative business before beginning their school day. While outside with them, I see younger classes also engaging in physical warmups – from running laps around the field to double dutch skip rope. Grade 4 observes a similar morning rhythm: they meet in the classroom, sing a quiet song to settle down, recite their morning verse and a subject-specific verse, each with different total physical response (TPR) gestures, and then sit for 10 minutes of "Quick Maths". After that, they take 20 minutes to play Four-Square outside. The teacher referees the games as little as possible, and students work through negotiations of fair play.

Socio-Emotional Check Ins.

"Circles" are a forum for discussion of non-subject related socio-emotional topics that have emerged for the class. Students and teachers speak as equals regarding challenging behaviour, communication, and ethical action. In the middle school Main Lessons observed, teachers also took time to address social, emotional, and mental health issues as they arose naturally in class.

Community-Building Events.

Classes in the high school were interrupted one morning for a 20-minute activity out on the field: every student and every teacher in the high school stood outside together. While I stood off to the side at first, I was quickly encouraged to join the spiral formation. We sang together (in canon), and then followed the Eurythmy teacher in a series of rhythmic physical exercises not unlike Tai Chi that left me feeling quite peaceful and part of the group.

While each of these represents a small insight into the many ways in which these interventions "disrupt" the traditional school day at TWS, they provide significant opportunities for students with respect to physical and socio-emotional wellness. Perhaps more importantly, they promote connection with classmates, with teachers, and with the school community as a result.

"We Teach Students, Not A Schedule".

In contrast to curriculum understood as a series of time-sensitive tick-boxes, teachers at TWS are free to respond directly to what is presenting in the students. In this way, they can meet the aims of a developmentally appropriate practice and respond to students' unique needs and context with student-centered learning practices. Teachers employed consistent use of one-on-one support for struggling students and adapted achievement expectations to meet the

individual's learning journey, instead of a standard metric. This flexibility extended to behavioural expectations, as well. Because the teachers know the students well, expectations are grounded in an understanding of their past experience and individual context.

One teacher commented: "I can only prepare my classes so much before I see the students, because working with them is what's going to tell me what they need, is going to tell me how and possibly what to teach". When asked about how they select course topics, another responded: "It all depends on the students and what's living for them". This represents a radically responsive form of educational practice, in which lesson plans are useful tools that may be thrown out the window if needed. Parents described the effect:

> I do think it supports them as individuals, like it really sees the child and their individual strengths and weaknesses and supports them as they present in any given moment. So in terms of like, confidence, sense of self, and purpose, I think it really, really serves them.

Supporting a Developing Self-Concept.

In one instance, I witnessed a young adolescent, who was an L2 learner, volunteer to read out the problem sets and answers in her math class while the teacher performed the one-on-one homework check in. Despite her willingness, the task was not easy for her. The teacher acknowledged her efforts with a smile. "Thank you, you win the prize for best reader". She returned to her chair *glowing* at his praise. This was repeated again and again in other classes, where students who performed to the best of *their own* ability, not the best *possible* ability, were warmly praised by the teacher – and often by their peers – for their efforts. The exhortation towards producing "beautiful work" observed again and again in classes echoes this understanding of assessment: students are encouraged to be their own metric, to do the best that they can in all that they do, and to take pride in that achievement. The limited quantitative

assessment present in the Lower School aids this goal, as it is difficult to compare oneself to the performance of others, especially when it comes to the different pace at which children meet hallmarks of academic achievement, such as reading. One teacher, who had transitioned to Waldorf from teaching in public school, made the following comment regarding a middle school aged student:

> If I didn't tell you it was [Name] who couldn't read, you wouldn't know because he is so brave, and so bold in how he stands in the classroom, and he feels so good about himself, and he'll let anybody help him. He's not hiding. It's not something shameful. He's not embarrassed - that's just who he is. And they're working on it [reading skills]. But in a public school, he would have been decimated.

This represents a critical building block in learning to learn: remaining strong in the face of adversity, taking pride in hard work for skills that do not come easily, and having a classroom environment that supports good feeling and self-confidence. When students are not penalized for their performance, struggle can be a good thing. The attention to the needs of the individual student generates a space for children to feel good about persevering in the face of adversity.

Building Resilience.

Given the emphasis on affect in learning, observations and interviews frequently demonstrated support for emotional intelligence – learning how to process emotions, how to be empathetic towards the emotions of others, and how to self-regulate. Conversations with teachers and parents highlighted the desire to build resilience in students. The emphasis on yearly class trips helps to develop collaborative learning and team building, but they're also intended to help that "inner person to wake up and recognize adversity is not a bad thing". Reference was also made to the bond a student can depend upon when they have the same teacher and the same

group of classmates for eight years as a component of resiliency. One parent highlighted the belief that these skills start in the physical body – that for her daughter, time taken for healthy development in one sphere translates into others:

> I think the physicalness of the curriculum, and being able to climb trees and do things in her physical body helped build this confidence in herself. Especially for a girl, I think that's so powerful, that "I trust this body of mine ", because I think it does map into this, like emotional resilience later. I trust that I can do this. I trust that things are okay, even if they're really hard. It's not that life is always going to open up for you. It's not. It's sort of a reality that life can be really hard, you're gonna meet obstacles, but it's not the end … you actually have power to get up again and try again.

While these are just a few examples, the school is actively trying to support students as they grow in freedom towards self-actualization. As such, technology use at the school is always considered with respect to this overarching goal of freedom, how it can support – or supplant – that pursuit in a developing individual.

Technology Integration – In School.

Although the school has been mis-characterized as a "technology abstinence movement", one populated by Neo-Luddites, this was not the view expressed by participants or seen in observations. Perspectives and practices are more accurately characterized as a desire to wait to work with complex technology when the student is ready to make the best use of it. One teacher explained:

> Beginning sort of middle school-ish, [the students are] starting to have the capacity to use it as a tool. They need to learn to use it as a tool, it's something they need to have competency with in their lives. And then they can actually make use of it. And if they're

> guided in the right way, and have the right limits placed on them, hopefully they can get through their teenage years without falling too much into the crutch rather than the tool.

This outlines a couple of themes that recurred throughout the research: this sense that there is a right time for something to be introduced so that it can be used appropriately, that students ultimately do need to be effective with digital tools, that structure from adults is helpful in the pursuit of success, and that there is the potential for these tools to be a barrier to learning.

Stretching and Supporting.

When discussing appropriate use cases for digital tools, many of the teachers were quick to highlight the benefits of digital tools and other accommodations for neurodivergent students and for high school students who were new to the Waldorf school. The school has an IEP coordinator who works with students, teachers, and parents to determine these adaptations while maintaining a good fit for the Waldorf program. This can require some adjustment:

> [On Psych-Eds] If they see one manifestation of an exceptionality, then it's like 'Here are all the accommodations', it's kind of like a ... copy and paste, right? So for some students, even when it says they should type or use some sort of assistive devices, for some students, it's actually easier for them to write by hand. And they actually prefer that.

Observation data confirmed that some students in the high school do take advantage of specific technology-based accommodations, bringing personal laptops to school for note-taking activities where other students are taking notes with pen and paper. One student was observed taking pictures of board notes instead of writing them.

For that same mother who wondered whether she would impact her son's abilities in coding, the *restriction* on computer use in class was a welcome shift from his public-school's IEP prescription for computer-assisted writing. While he is certainly looking forward to using a

computer to type essays in high school, she's glad he was forced to write by hand at Waldorf: "It was never his forte, and it's still not, but he's probably 10 times better and more capable of doing it now than he ever would have been. For sure, the fact that he didn't have access was beneficial." This comment was echoed in the words of a teacher: "If a child has a psych-ed assessment early on, and all these accommodations are put in place, that doesn't necessarily allow them to stretch themselves, they've been given crutches ... there's a balance between the two, which is stretching and supporting". When it comes to accommodations and psych-eds, it's always about finding a balance, and the same is true for technology more broadly.

Developmentally Appropriate Technology Available at the School.

In the Lower School, digital device use for instructional purposes is non-existent. Teachers use the classroom blackboard, and physical artifacts such as maps, paintings, and posters for visual support when needed. There are no screens used for learning until middle school, at which point the Computer Cart can be used by teachers to display external media resources. In the High School, students use a basic LMS portal to communicate with teachers, share resources, and submit assignments. Projector screens are present in Grade 9, 10, 11, and 12 classrooms, as well as the three science labs. There is also a TV screen present in the Art classroom. Students are permitted to use personal laptops or tablets in class for specific instructional purposes and they are also permitted to use cell phones in class for specific instructional purposes. The WiFi network is not available for student use (with the exception of rare instructional permission granted by a teacher). The computer lab is available for High School students to use on their lunch break as part of the lunch time Homework Club (students can also use their laptops at this time) and the lab is also available for teachers to book for their classes during the school day. It houses 19 iMac computers, which are connected to the internet

via ethernet. Students log in using their individual credentials, sessions are wiped upon logging out, and use is governed by a posted ICT use policy. Available software includes: Adobe Suite – Photoshop CC (2019), Illustrator, Premiere, InDesign, Premier Pro, Lightroom; Microsoft Suite – Excel, PowerPoint, Word; GeoGebra Classic 6, Geometry, Graphing Calculator; iCircuit; QGIS (open source Geographic Information system for mapping Geospatial data); Arduino; Python Launcher; Master of Typing Tutor. Students also have access to a 3D printer and AutoCAD.

Excel-Ing: Use of Learning Tools in Context.

In the Grade 12 Data Management class, I get to watch my first "learning with technology" moment at TWS. Each student has their laptop out and the teacher projects his screen onto the projector screen with AirPlay. Students follow along with his demonstration of Excel functions to calculate Standard Deviations and acquire some attending Excel skills in the process (such as different filtering tools). The students had been introduced to the concept of SDs in an earlier class, and this lesson provides an avenue for them to work through a large dataset quickly, getting a feel for the concepts in a more complex context. After about 25 minutes, the teacher announces: "The technology portion is over now!" The students put away their laptops and class continues with paper and pencil problem sets from their textbook. Notably, there is very little lecturing from the teacher: the instructional strategy is more dialogue based, in which the teacher asks questions to introduce a concept, elicits responses from the students which lead to further questions, and then summarizes the concept with additional information. The students are actively engaged. For the last 10 minutes of class, the students open up their laptops again to work on their final projects for this course: analysis and visual presentation of survey or

research-derived dataset. Topics are chosen individually and range from ‘medieval siege efficacy over time’ to ‘home prices in the regions of Ontario’.

Overall, this class procedure highlights two key considerations for learning with technology at the school: use is limited and intentional. It also exemplifies a classic pedagogical practice at the Waldorf school, and part of the reason many teachers are reticent to rely on digital tools for teaching and learning: back and forth dialogue between the students and teacher is critical for learning, facilitating engagement, retention, and understanding.

General Observations of Teaching and Learning Tools.

Teachers used projector screens to provide visual reference for class material, such as displaying an essay and working through it line by line or showcasing notes from lecture. They also showed external resources, such as documentary film and art. Students in the high school were observed in the computer lab using the computers for web-based simulations and experiments, research, presentation preparation, and word processing. They were also observed using personal laptops and cellphones in class for instructional activities.

Transitioning From No Tech to Low Tech.

There was no observation of ICT used as a learning tool for students until Grade 8. One student in the Grade 8 class referred to emailing the teacher work, and the teacher confirmed to me later on that she encourages all forms of communication. Students in Grade 8 are issued school email addresses to prepare them for the transition to digitally mediated interactions with their teacher in high school. At times, students in middle school are asked to use their home computers to use teacher-chosen websites for research, and to type up notes to support their Main

Lesson work (most of which is still handwritten). Typing tutorials begin in middle school, given the benefits of ergonomic keyboarding habits.[34]

The most significant curricular support for the transition from screen-free learning to increased digital device exposure is the CyberCivics program. This is a three-step course that is offered in Grade 6, 7, and 8 to foster 21st century competencies, exploring issues around digital and media literacy, and digital citizenship.[35]

CyberCivics – Experiencing the Cognitive Cost of Multitasking.

The Grade 8 class is buzzing with the presence of a TV in the classroom, which indicates to me that screens are not a common occurrence. The IT coordinator has set up the Computer Cart for today's CyberCivics lesson on "Multi-Tasking" and the teacher introduces the lesson with a discussion prompt that asks students to consider how multi-tasking presents in their daily lives. Next, she moves on to the video presentation, which demonstrates different formulations of selective attention tests.

When she goes to start the video, the sound isn't working. She pulls out her phone and texts the IT coordinator to come back, and I watch as three students leap out of their seats, and work together to troubleshoot, changing the audio input in under a minute. Despite the lack of technology use in the classroom, it's evident that they are getting some exposure to computers at home. Throughout the video, the students gasp and exclaim at the various reveals. Once the video finishes, the screen is turned off and students work through a paper and pencil multitasking

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[34] While this is normally introduced as a multi-week activity in middle school (Grade 6, 7, or 8 depending on the teacher) in which students are permitted to use the computer lab and for the Master of Typing Tutor software, COVID protocols have prohibited this from taking place recently. As a result, parents have been encouraged to support the students in their typing skills at home.

[35] TWS has been using this program for over five years and first heard about it through AWSNA, as it was developed by a Waldorf teacher in the US.

activity which demonstrates the cognitive cost of switch tasking. Offline learning takes a larger share of the CyberCivics lesson, and it is in the hands-on, experiential activity that students can develop a more personal understanding of the material.

Observations of this lesson contextualize much of what I'm going to hear from practitioners throughout my interviews: that technology in the classroom has its limits, especially if the goal is transforming information into knowledge and promoting deep thinking. The spectacle of the selective attention test is exciting but the students need to do the work themselves to really *get* it.

High School Technology Education.

In the High School, computer related curriculum picks up from CyberCivics with the Grade 9 introduction to Main Lesson on Electricity, in which students practice basic skills in electrical wiring and hands-on circuitry. They take up this thread again in the Grade 10 Computers Main Lesson, where they look at the history of Information Technology, analyze the transformative power of tech revolutions, and build rudimentary computer hardware. In Grade 11, the school has historically offered a Business Technology course, which continues skills in Graphic Design, but this course was replaced during the pandemic with topics in social justice and ethics from the perspectives of marginalized populations. The sole technology-related offering for Grade 11 is now the Technology Design Main Lesson block.

Developmentally Appropriate Technology Integration – At Home.

Given the necessities of online learning, all students have access to computers at home and parents note that teachers encourage limits on digital device access in the home. Parents also appreciate that there is little-to-no need for students to use a computer for homework in the Lower School, as it makes it easier to negotiate limits and boundaries around digital device use.

Boundaries and Restrictions.

Parents discussed the importance of boundaries and restrictions around screen time and content, noting that technology use in the home is not so different from other rules needed to help kids develop healthy self-regulation and independence. Some highlighted rules around time, such as limited or no media during the week, and most used a more relaxed approach on weekends, with families typically engaging in some kind of family co-viewing experience, such as a Friday night movie night. One family who gave their child a cellphone in Grade 6 clarified that it is strictly for communication with friends, no YouTube or social media engagement, and that it stays with the parents overnight. Additional privileges are directly linked to demonstrations of responsible behaviour: “I'm not ready to give her what she asks until I see the responsibility for other things like chores and homework and practicing like violin and piano. I'm only giving her how much she can handle”. Worry over content was a common theme for parents and while appropriate subject matter and non-violent content was discussed, some were equally concerned with the editing and pacing in a lot of contemporary youth programming. They found the level of noise, flashy editing, and overall sensory input was inappropriate and had a negative impact on their children’s well-being when compared to their response to older programming. Parents drew attention to the emotional issues that present when students have to transition off of their devices, be it television, iPad, phone, or computer time, noting issues of moodiness and increased fights between siblings after media exposure of more than an hour. They also pointed out the challenge that siblings can play in the debates over screen time and content; while more freedom is appropriate to the increased responsibility of an adolescent, it is difficult for the pre-adolescent sibling to accept the difference.

Shared Purpose, Different Approaches.

The parents valued being a part of a community oriented towards developmentally appropriate screen use as it's easier to set boundaries when they are shared. One parent noted that as her kids got older, she needed to go "cold turkey" on recreational device use during the week because they would consistently fight with her when it was time to get off. She told me she would not have been able to do it if it weren't for Waldorf; they didn't *need* cell phones or computers for social reasons because their friends didn't have access either. Some parents have rallied behind the "Wait til Eight" movement, in which students do not receive a personal cell phone or any other personal digital device until Grade 8 but others have elected to provide a cellphone (with limited features and access) as early as Grade 6. In this way, approaches to introducing screen-time and digital devices developmentally are similar but not exactly consistent across families.

A number of teachers and parents expressed concern for the ways that digital devices are easy remedies for boredom. Quick entertainment can rob students of chances to be creative or social when it is too readily available. One mother took this even further, articulating her concern for the loss of "quiet contemplation" from something as simple as audio books, which she first started using as a screen-time alternative. She explained:

> In general, humans are really uncomfortable with silence. And I have seen that my children are uncomfortable in silence. And they fill that silence with audio books. And it's been a real issue for me because it helps me feel like I'm getting the peace that parents get when they put their kids in front of a screen. They're not making as many messes. Nobody's fighting. And it feels a lot more nourishing. But they're still filling the silence with something. I think screens speak to this human nature we have for just being

> uncomfortable with ourselves and with silence […] The value of silence is to give yourself moments to tune in with how you're feeling, where you're at, how your body's feeling. All of those things that are really key for mental health.

Both parents and teachers pointed to the negative effects of total abstinence from digital devices. In one family, the father was a Waldorf graduate who had experienced very strict restrictions on media engagement in his youth. As a result, he was adamant that that not happen with his kids, as there is a "danger when it becomes so dogmatic". Teachers acknowledged the same, suggesting technology abstinence turns it into "candy" and then the students' "craving is just over the top".

Tension: Defining Responsibility and Age-Appropriate Recreational Practice.

Analysis of observation and interview data revealed that while parents and teachers share the common goal of developmentally appropriate technology use, the best way to reach that goal is up for debate and the division of labour can get complicated. The degree to which digital devices can be used recreationally is a point of tension between some teachers and parents. One teacher commented that it's important for parents to evaluate whether personal digital devices are really needed, pointing out: "We have Grade 1 kids that have a phone in their backpack, hanging on a hook. But that's parental anxiety. It's not the child's need." While many families set up hygienic digital device practices in the home, some take a more relaxed approach when their kids are younger – and get into trouble when they enter adolescence. Then, they want the teachers to step in and help. While teachers in the high school do engage in parent education efforts (for example, pre-pandemic the school hosted a viewing and discussion of the documentary film "Screenagers" for parents and students), they try and limit their actions to the school context: "It's not our job or our role to go and tell parents how they should parent their

child, we can just say, here are some suggestions, and then you work it out". They acknowledge that there is significant overlap in supporting emerging self-regulation around device use and other risk/reward activities for adolescents, such as underage drinking. Teachers and parents try to use these moments to encourage developing capacities in self-control and self-regulation.

Some teachers feel that the recreational use of digital devices has a negative impact on students and the perceived efficacy of the 'Waldorf education':

> We are actually finding that our students in Middle School and in Lower School, because the parents have made technology available at home, they're not able to do certain things […] If parents are signing up for not having tech and now all this technology is available to them [at home], then our curriculum, and our education suffers, as well.

While some parents agree that digital device use should be curtailed to ensure Waldorf educational principles can actually work, other parents expressed unhappiness at being judged by teachers for letting their kids engage with media at home. They believe they are making intentional and appropriate choices and that teachers, especially in the Lower School, are unwilling to see them as such. One parent commented: "There was absolutely a time my husband and I had to make a decision, how much of what these teachers are telling us we have to live by and how much of it we say doesn't work for our family".

Evidently, while the teachers retain control over device use in the classroom, and parents retain control over it at home, the lines of effect from the two activity systems can bleed into each other. Teachers are called upon to try and solve the problems of ineffective parenting strategies, intruding into the home activity system, and home use of digital device impacts the experience of the school day, intruding into the school activity system. Most importantly, conversations between parents and teachers continue to shape an evolving picture of what

developmentally appropriate technology integration in the overall experience of a 21st century student's life should actually look like.

In summary.

In contrast to stereotypical perceptions, teachers and parents at TWS do not practice digital abstinence policies. The school is equipped with up-to-date ICT in classrooms, which teachers and students use in a limited and intentional capacity to support learning activities. Use is mediated through a desire to seek appropriate and intentional exposure to digital devices for pre-adolescents and adolescents at school and in the home, privileging activities which support physical and socio-emotional development in students. Teachers attempt to respond directly to what is presenting, teaching students, not a schedule. Despite the shared vision for appropriate practice, disagreement exists between parents and teachers on how best to achieve that goal when it comes down to the details. With an understanding of what a developmentally oriented community looks like, let's examine how TWS makes decisions of "appropriate-ness" and how they cope with less-than-ideal educational circumstances.

How Has This School Approached Recent Periods of Compulsory Online Learning?

For teachers and families concerned about the impact of overexposure to digital tools in educational settings, Ontario's shift online for much of the 2020 and 2021 school years pivoted away from their preferred method of educational delivery. Just like other schools which remained closed during lockdown, TWS also engaged in mandatory online learning, using digital tools to deliver learning. While participants felt the school's approach to online learning was a success, they were eager to return to in person schooling. Nevertheless, some changes that occurred during the pandemic have continued in the return to in-person, especially those which impact administrative and adult-facing communications.

Technology Infrastructure to Meet the Needs of Online Learning.

While not all families at the school had computers at home before the start of the pandemic, challenges with compatibility (using tablets and cellphones to engage in online learning) quickly necessitated computers for all students. Every family at the school had access for their children and no devices were provided by the school, with one teacher acknowledging that "the affluence" of families who attend the school made this kind of investment in digital tools possible. The school has provided teachers with MacBook laptops since 2018 and these were used to support online learning. Generally speaking, families and teachers reported no challenges with WiFi or broadband access during the pandemic, but there were some instances of slower internet or data limitations in the early days. Notably, as it became clear that mandatory online learning was not a short-term measure, the school invested in an owned fiber optic line in 2020 to provide teachers with consistent, high-speed streaming for classes.

Instructional Strategies.

Classes were held over Zoom and parents and teachers reported fast video streaming and few technical challenges overall. Most teachers favoured low-tech solutions over high tech presentations. High School teachers generally used more sophisticated tools such as writing with a stylus and online whiteboard, and Lower School teachers were more likely to teach with a blackboard or physical whiteboard.

Some teachers augmented their practice with cell phone cameras (providing two or three camera setups for activities). For example, one Lower School teacher worked through a Main Lesson on fractions with cooking activities, with one camera on the activity and another on her face. One High School Science teacher used a combination of iPhone, iPad and the school-owned MacBook Pro to live-stream experiments in Zoom classes. Generally speaking, teachers

used a mix of live classes and pre-recorded lectures, though some did not feel the pre-recorded lectures were as engaging. There were no references to the use of premade PowerPoint presentations or outsourced YouTube video lessons/tutorials. After an initial reliance on email communication, the school's plans for an LMS portal were expedited and this was used to support communication with families during the pandemic. It was also used for High School students to submit assignments and tests. Teachers and parents noted that students used online networking sites such as Google Hangouts and FaceTime to socialize with each other during the pandemic and to facilitate group study efforts.

Tension: Navigating "Appropriate" Screen-Time.

Teachers and parents both spoke to the challenge of determining how many hours a day students should be online for class. Early in the pandemic, the school offered limited programming (one to three classes a day), recommending offline activities which often required parental support. As the mandatory lockdowns persisted, parents grew dissatisfied with the school time offered:

> So their initial response is, 'Well, we can't put the kids online too much'. And I was not happy at all in the beginning. And then as time went on, I guess they realized, 'Well, this is the only way we're going to be able to do this'. And so they got more comfortable with it. And the schedule ramped up, and it became really good.

Nevertheless, TWS stopped short of offering a standard six-hour school day (in contrast to public-school programming) throughout the pandemic. One teacher articulated to me: "It took a real stance to be able to say, "We are limiting the screen time that we are offering to this much not because we can't offer more, but because we think that it's irresponsible to". The faculty felt it wasn't good for the students, nor was it good for the teachers. Teachers recognized that even

the high school students struggled with Zoom fatigue after three hours of class that included frequent breaks and incorporated movement in the lessons.

This stance that "it's not that we can't, it's that we think it's irresponsible" parallels the school's position on technology-mediated learning for in-person schooling. It's not that the infrastructure isn't there or that the teachers are not capable of working with it; use is limited and intentional on purpose.

Parent Satisfaction with Online Learning at TWS.

Overall, parents reported high levels of satisfaction with online learning once the teachers expanded the number of hours in the school day: "I think both of my kids can learn very well online and their teachers executed it really well […] it was the best way that I could have imagined for my kids to have to be learning online". Another parent acknowledged that she was particularly pleased with the way homework was structured during online learning: "What I appreciate so much about Waldorf is that the homework is not connected to the computer. So they're online for the lesson, but their homework can be done without the computer." Both of these parents pointed out that their biggest challenge with online learning was getting the kids off of the computer when class time was finished, citing the same emotional challenges and conflict-oriented behaviour that had led them to limit digital device use more strictly in the first place. Evidently, while online learning provided a path to emergency instruction, the practical challenges that persist with digital device engagement did not disappear.

One family I spoke with had pulled their kids out of Waldorf during the pandemic, enrolled in public school online learning, and then eventually switched back to Waldorf for online learning. They spoke to the differences in online learning programming for their three children:

> The public school is basically on all day. They give them the assignment and the kids work on the assignments. So they're not like on the screen 100% of the time. But I do notice that they give them so much work that they cannot finish […] they ended up staying up past 8pm. And that's also because their attention span during classroom hours is very poor. All three of our kids - when they were doing the public school online – they started either watching YouTube during class or playing games. So the homework is left for after school, which they could never finish […] They give them breaks like PhysEd. But it's sometimes just a slideshow, and they have to click on videos like YouTube videos. And then they kind of have to self-lead, which is very difficult. But in the Waldorf system, the teacher is there and they're engaging with the students. They're asking questions, they're incorporating some movement. And they don't use as much technology as the public system, which uses a lot on YouTube and showing movies at lunch. They use a lot of outsourcing. And that's so distracting. And they pile on too many subjects in one day.

Overall, while each family felt satisfied with the online school experience, they were eager to return to in-person schooling, which provides greater avenues for social interactions with peers, active learning, and motivation for learning.

Benefits of Using Zoom.

Some High School teachers acknowledged affordances in online learning, such as greater intimacy for class discussions and ease of integration for external resources (such as video sources). Generally speaking, however, the experience of transitioning online has not resulted in significant changes to classroom practice. Where it has made a significant impact is at the adult-communication level. Teachers felt that Faculty meetings and Parent-Teacher conferences are

more convenient when hosted through Zoom. Administrators also acknowledged improvements to their workflow and team building with remote video communication, noting that it makes weekly meetings more convenient for each member to attend. One administrator pointed out that the benefits of remote communication only go so far, however: “If we never saw each other face-to-face, it would not be the same either.” The benefits of remote work tools are understood to be dependent on the presence of in-person interactions, as well.

In Summary.

Despite the community’s preference for screen-free learning, and their initial challenges with a “slow start” to the online school day, mandatory e-learning at TWS was perceived to be a success by teachers and families. Teachers, parents, and students were able to move online effectively, despite limited technology use during regular schooling, and infrastructure support allowed for teachers and students to engage in video-based activities. Instructional strategies relied on simple digital tools to support teacher-led learning activities, which engaged students in demonstrations and question and answer dialogues, much like in-person schooling. While the use of the LMS portal is the only change to the student experience that has continued into in-person learning, faculty meetings, parent-teacher conferences, and administrative workflow have all been transformed by the exposure to remote work tools. This underscores the school’s approach to technology as developmentally-oriented: Digital tools can support positive transformation for adults but they should not replace the screen-free school day for children. Perspectives and practices during compulsory online schooling re-affirm the idea that the screen-free learning at the school is not an accident or a lack of knowledge, but a choice made intentionally.

How do the Different Drivers of Teachers, Parents, Students, Pedagogists, and the Ontario Ministry Of Education Interact to Affect Technology for Teaching and Learning at the School?

"I think a lot of parents are looking for a low-tech education"

Broadly speaking, the level of digital technology used in the classroom at TWS has increased since the MacLean's feature in 2005 for two reasons: there is more money to invest in infrastructure and the attitude towards learning technologies has shifted as younger teachers have joined the faculty. In the last five years, the school has made major infrastructure investments, buying new laptops for the teachers, implementing learning with technology tools in the High School classrooms, and installing their own Fiber Optic connection line. Frequency of cellphone ownership in the student body has also increased dramatically and as a result, the choices of parents and teachers have created an environment for pre-adolescents and adolescents in which digital tools are available both at school and at home.

The Transformative Power of Yondr.

In 2018, TWS introduced Yondr pouches[36] in the High School program, in response to challenges with behavioural management and social engagement due to increased cell phone ownership. Teachers found that the students' "ability to moderate their own use" was limited, forcing teachers to have to "deal with cell phones in the classroom". They also found that at lunch time, "instead of what used to happen – everybody chatting and interacting with each other – we started seeing people alone on their device. The creation of a social atmosphere is so

[36] Yondr pouches are one brand of magnetically sealed carrying cases. They are typically used at concerts or events where there is no photography permitted. The phone is placed inside the padded pouch and sealed inside, and the owner retains possession for the duration of the event. When the event is over, the pouch is opened with a magnetic lock and the pouch is returned to the organization.

important in this school, so we needed to remove that particular hindrance." The program has been a huge success for the school, with one teacher describing it as a "game changer". Observational data recorded no instances of off-task behaviour or distraction linked to cellphone use in classes. Students put their cellphones into the Yondr pouches in the morning and release them at the end of the school day (via a magnet kept locked away by the teacher). Students sometimes used their phones for instructional purposes, such as looking up images to support design activities. They also listened to music during work periods in art class.

Faculty, Administrators, and Parents Contribute to Technology Use and Change.

How did the Yondr program come to be? After one teacher used the pouch at a music venue, they pitched the idea to the rest of the High School faculty, and it was approved by the Faculty Council. After securing funding approval from the Director of Finance and the Board of Directors, the school implemented the program shortly thereafter. This exemplifies how policy changes at this school occur "from the ground up". Because the school is not governed by a schoolboard or a district superintendent, changes tend to start from within the activity system and emerge through decision-making structures made up of teachers, administrators, and parents.

The school uses a decision-making matrix process to structure change management, and categories such as "Budget", "Major Program Changes", "Parent education and programming", "Annual pedagogical focus and goals", and "Long term strategy and planning" are assigned to different bodies. For example, "Long term strategy and planning" requires a coordinated decision between all members of the Board (including the Pedagogical Chair and Director of Finance) and the Faculty Council, in addition to input from the rest of the administration, faculty, and Parent Council. "Major Program Changes" require a decision from the Faculty Council, Pedagogical Chair and Director of Finance, and input from members of the Faculty, while other members of

the administration, Board, and parent body are informed or invited to offer feedback. In an effort to describe this process in context, let's take a look at how projector screens came to be a part of the High School.

The Projector Screen Story: Achieving a 'Chalk-Free' Experience.

If the effect of integrating AirPlay projectors is a more modern and up to date classroom, this was not the early impetus for bringing these tools into the school. For one teacher in the High School, a chalk allergy prevented the use of a Waldorf staple: blackboards. As a result, they personally invested in a digital projector and iPad with stylus for their classroom, projecting digital notes for students. Over time, some other teachers pushed for the same type of technology to be purchased for all of the high school classrooms:

> My colleagues were exploring how they can involve technology as well - here we were running around with these CD players and cassette players, running up and down the stairs looking for crap that should have all been in one place. And so they too felt that, "Oh, you know, [I] can play the videos, [I] can do whatever [I] need ...How is it that we can't have that in high school? And so there was a bit of a backlash, because there are quite a few people who don't feel that that is the way to go in the classrooms. So although initially they thought that they should do Grade 5 and up, there was a whole lot of back and forth. And so it was settled that in the high school classroom, at least, we'll put the screens and we'll put the projectors, and Apple TVs so that, if you needed to connect to it, you could actually do it.

This highlights the persistent difference of opinion present within the faculty with respect to technology use. As a joint Lower School and High School initiative, it could not pass because not all of the faculty members implicated in the decision could agree. Put forward as a High

School-only budget issue, it required a decision from the High School Executive and the Board. The school's organizational structure allows for the Lower School and the High School to operate relatively autonomously in their own spheres, which can lead to challenges in middle school transitions. One Lower School teacher I spoke with was actually unaware there *were* projector screens in the High School classrooms, further underscoring this independence in practice.

In this example, change was motivated by an individual's need, which inspired a change in practice for others, but the range of effect was limited by critical decision-makers. Unsurprisingly, these decisions are often linked to personal perspectives on technology.

Tension: Use of Learning Technologies for Instructional Purposes by Teachers.

Although digital tools are present in the High School classrooms, and portable screens are available for use in the middle school classrooms, not all teachers take advantage of them equally, and this discrepancy is linked to two key factors: attitude towards the impact of technology on teaching and learning, and personal knowledge and comfort with digital technologies. Changes in these two factors have contributed to the significant shift in the acceptance of ICTs at the school over the last 20 years. While it's difficult to categorize the standpoints of faculty members, in *very* general terms the older teachers were less likely to integrate tools (with some exceptions), and those who are less comfortable with digital tools are less likely to use them in their teaching practice (again, with some notable exceptions, especially teachers for whom subject matter expertise is linked to STEM).

While some teachers feel ICT in the classroom is unnecessary, others have embraced elements of it. Some suggest "It's a distraction" while others feel "It opens up a different perspective". Steiner's exhortation for teachers to bring the lesson to life through their own

understanding of it was referenced as a reason not to use ICTs, while others feel that it can provide students with access to real people voicing their experiences. The topic of active and passive learning with technology also emerged, with one teacher cautioning: “No matter how you dress it up, what technology in the classroom provokes in children is merely reaction – it does not stir creation or allow them to create”.

The faculty remains diverse in its perspectives and practices with respect to technology use. Notably, while teachers are not forced to use ICTs, neither are they restricted from using it as they see fit. Teachers maintain a high level of autonomy in their classroom practice, and so these debates around technology use emerge in conversations with other teachers and faculty meetings more than they do in evaluations or assessments of learning. One teacher commented: “There's always a spectrum of some people, of different styles and philosophies. I wouldn't say everyone’s on the same page … And so finding that balance**,** within each of us, and then as a faculty, is really what we strive for, and we’re not always successful.” This theme of finding the balance emerged frequently in conversations about technology use.

Use of Digital Tools to Improve Teaching Practice Outside of the Classroom.

One point of agreement between teachers was the benefits of digital tools to support their job *outside* of the classroom. Having laptops to prepare lesson plans and share resources over the school’s networked storage drive improves elements of their practice, such as providing external resources for students in exceptional cases (for example, providing lecture notes for IEP students), the organizational aid of digital file storage, improved supply teaching outcomes, and communication accountability with students and parents. Teachers expressed a desire for more training and support in learning how to use digital tools to support their teaching practice, and

the IT coordinator at the school has also requested additional technology education for the teachers.

ICT Integration Mandated by The Ontario Ministry of Education.

Surprisingly, there was no evidence of influence from the provincial accreditation process. Course offerings are required to align with "Growing Success" and the school passes inspection every two years without difficulty. When asked about the inspectors' response to limited ICT use, teachers commented that it has never come up as an issue and pointed out the inspectors are satisfied with the engagement levels in the classes without ICT use.[37]

Another surprise was the fact that for many years the school offered an accredited Computer Science course for Grade 11 students, and do not anymore because they disagree with the specificity of the learning outcomes that have now been mandated by the province:

> The problem with the Ministry [of Education] credits, is that there isn't a credit with the right topics. So it's either, coding or whatever. The courses that we could teach for credit are not broad enough and actually we want them to have fundamental knowledge across the board. I picked up programming in university, and there was no such thing as access to a computer. So it's something you can learn if you need to. And it's better to just have a broad, broad academic experience, I think.

The most dramatic example of the provincial educational authority's influence on the teaching practice is the emphasis on quantitative assessment present in the High School.

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[37] One teacher explained: "For many years, we had inspectors that would come in, and, and we know that the inspection often just takes half a day. And then for a while, we were ending up with inspectors that were spending the whole day with us. And it made us nervous to start with, and then we realized it was actually just because they wanted to spend more time in the classrooms. They couldn't believe how happy the kids were, how engaged the students were. And so they just wanted to observe. Many of them would comment to say, "We wish that more schools could tap into what you have here".

Traditionally, Waldorf schools do not offer quantitative marks until Grade 12 – at TWS, marks are present on report cards from Grade 9 and up. Nevertheless, it was clear that quantitative assessment is less meaningful to some teachers than qualitative, and that they feel its presence can actually discourage students' willingness to participate in the pedagogical emphasis on play.

The Influence of Pedagogists and AWSNA.

Analysis revealed no direct input from AWSNA regarding teaching and learning with ICT but lots of indirect guidance. The faculty often communicates with other schools under the AWSNA umbrella on best-practices and many of the teachers mentioned conferences that AWSNA holds as sources of knowledge to support decision-making.

Cumulative Efforts Towards ICT Education for Students Are Small-Scale and Organic.

If ICT use is discretionary for each teacher, ICT education for High School students is not. Teachers believe it is important for students to graduate with foundational technology-related competencies needed to succeed in university and in life. While there are specific technology education courses, there are no formal guidelines dictating digital skill development across curriculum. In the absence of external standards for ICT education from the Ministry of Education or AWSNA, teachers deploy technology education for students when and where it is needed based on the assessments they're doing of students throughout the year:

> Around eight years ago, I had to take over Grade 10 Career Studies in a pinch. And the Ministry [learning outcomes] are negligible, we could meet them with our eyes closed. And so what is it that Grade 10 is in need of right now? And PowerPoint skills was one of the things that we identified … we were getting them to do PowerPoints in various classes as a means of assessment, but there were students for whom they could pick it up

intuitively, and students for whom that was not happening. And so we used the time to work it through with them, and have them also share their own skills and teach each other "Okay, what makes a good PowerPoint?"

Regular conversations between faculty members had identified a need for improved PowerPoint skills in students and when a teacher was met with an opportunity to meet that need, they went for it. Teachers also modulate the use of learning technologies based on the practice of other teachers, increasing or decreasing as needed. This is done in an effort to generate a more balanced, whole-day experience for the students from class to class.

'Meeting' The Students.

The High School faculty gets together at the end of each school year as part of their "Plan, Do, Review" where teachers consider what's working and to ask: "how do we make sure that we are still meeting the students?" Here, the faculty embraces their flexibility to change the curriculum to better serve the students, which the teachers acknowledge is different from the experience of public-school teachers "who are not a part of the innovation, even when they want to be". At TWS, the scale of practice means that the students are known by every teacher in the department, and their contexts and competencies are considered directly; correspondingly, change is incremental, rather than unilateral, and rooted in student need. These conversations reflect the multiplicity of perspectives present in the faculty, as teachers attempt to find the balance between tradition and change.[38] When asking about the interactions between Waldorf pedagogy and teacher practice, I was surprised by how few references I heard to Steiner's writings, especially from High School Faculty teachers. In response, one teacher explained:

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[38] Again, curriculum is understood as the full day experience that supports a student's thinking, feeling, and willing, not just a list of subjects to be taught.

> That's because Steiner had very little to say about high school. And beyond the pedagogical, Steiner had jack all to say about a computer – for obvious reasons. We often, not just our faculty, but even connecting with other schools – largely thanks to the power of Zoom in these last two years – get to something where there's a rub, and it's like, 'Okay, should we change? Or are we losing something by changing? Was there wisdom in it? We've been doing it for 100 years, but maybe it's not right, but it's been working … Someone always says, inevitably, 'If Steiner were to walk into our school today, would he be impressed that we were still teaching the curriculum that he was talking about 100 years ago? Or would he be pissed?' Like "I told you to be living in the times that you are living in [laughs], why are you teaching things that were relevant a 100 years ago, but are not relevant today?" This balancing, I think - anybody could play a good round of 'Steiner Says', and you can always find your way out by saying, 'Yeah, but ultimately, you're supposed to meet students that are in front of you', with deep pedagogical insight and a deep understanding of the developmental stage of that child'. And if we're striving for that, then we're doing what he asked.

In Summary.

Technology change at TWS occurs in relation to on-the-ground needs, in contrast to top-down policy decision-making. Because the school provides infrastructural support and limited policy on teaching with ICT, the individual's perspective is frequently the determiner of their practice. Notably, the High School faculty work together to ensure students have the digital skills needed for success. There was limited evidence of direct influence on practice from outside the activity system, though parents and AWSNA are able to exert indirect influence, and specific parents act directly on technology changes as members of the Board or designated committees.

How Are Decisions About 'Appropriate' Technology Use Made?

"You've probably heard all the stereotypes … That we're 'technophobic' or whatever"

Many of the participants, be they teachers, administrators, and parents, made reference to the need for 'healthy' and 'appropriate' use of technology for young people. When asked about why technology integration is delayed until middle school, one teacher responded:

> If you've got iPads in the classroom, rather than children speaking to each other, playing together, interacting in a tactile way with the material, it's a different experience. We know that we learn things differently when we learn them, especially at a young age, when we learn them physically. And we move and we draw, and we write. And we hear things, and all of those senses are at play. We absorb those things way more. And I'm not someone who can speak to that from a neurological perspective, I can just observe that when children listen to a story that's been told to them or read to them, it is completely different than if they are hearing it or looking at it on an iPad or hearing it through a recorded means. And I'm not saying those things shouldn't exist. So it's always about finding the balance and finding what's important and necessary and not going too far in any one direction […] So this is just instinct. I mean, I read neurological research but instinct tells me that until they've reached a certain developmental stage, a screen's so easy, and it's so easy to get involved in. And it's so hard to have the maturity to not get sucked in, and to use it as a tool.

This example showcases several themes that emerged in conversations and it captures three of the major information sources that teachers and parents rely upon in their decision-making: research, experience, and intuition. There is this sense that "too much" can be harmful and that "too early" is a predictor for trouble. There is concern for healthy development, and the

potential for addiction, in addition to a desire for effective learning and engagement. Once again, this desire to find the balance emerges in the consideration of appropriate technology use.

Sources of Information Used in Decision-Making.

Teachers and administrators referred to AWSNA conferences, research articles (especially neuroscience, education, and technology resources), podcasts (several mentioned Lisa Damour's, as they had originally encountered her as a speaker at an AWSNA conference and pointed out that podcasts often lead to the discovery of new articles or books), and documentaries (such as *Screenagers*). Teachers described internal information sharing practices at the school, in which one teacher reads an interesting article and passes it along to others to read. They also pointed out that contemporary science is increasingly proving ideas that Waldorf practitioners have long held, based on the pedagogy's roots in observation and experience.

Parents also utilized podcasts and research sources, but they were oriented more towards organizations (such as the American Pediatric Society's recommendations on screen time limits) or articles (one family mentioned the Silicon Valley/Waldorf articles). Parents pointed to the value of documentaries like *The Social Dilemma* in facilitating conversations with their children about healthy use of digital devices. Parents also appreciated talking to other parents and highlighted the benefits of social media parenting groups. They use them to connect with other Waldorf families, sharing their perspectives and practices on technology use, especially in groups such as "Flexible Waldorf", for parents who engage with less traditional practices such as using screens or plastic toys.

Notably, parents and teachers referenced the need to engage with non-Waldorf groups as a vehicle for getting beyond the Waldorf "echo chamber". Some participants also referenced specific books that had impacted their decision-making, such as Nicholas Carr's *The Shallows*.

While none of the teachers or parents brought it up, the book *Raising Humans in a Digital World* by Diana Graber was spotted on a couple of bookshelves and desks. Again and again, these references to external information sources were accompanied by the acknowledgement that their decision-making is ultimately "mediated by intuition".

Use Cases.

Participants were quick to clarify that digital tools can have a wide variety of use cases, both in the home and in school, and that decisions about appropriate use can vary depending on the context. Distinctions were drawn between devices used as tools or as toys, active and passive use, and the benefits of tools when they facilitate the creative process. Generally speaking, participants felt that digital technologies had a role to play in supporting learning for high school students, if not for elementary school students, as they have the maturity to handle them more effectively and to actually use them as tools.

Participants demonstrated knowledge of how teachers in other schools are using technology in the classroom and maintained they are not interested in bringing in those use cases to Waldorf classrooms; some question whether educational games really qualify as tools, and some feel that the educational viability of internet-based information remains up for debate, given subjective and often inaccurate sources. They also pointed out that the speed of information taken in via digital devices is too fast for students, especially pre-adolescents, to properly integrate, process, and evaluate.

Tension: Is Technology Wholly Neutral?

In these conversations about use cases, many participants maintained that as long as technology is able to be used as a tool, then there is a place for it in the classroom. Here, a tension emerges between participants who regard digital devices as 'neutral tools' and those who

do not. This tension was best expressed in two statements made by different teachers. The statement: “Technology in and of itself is neither good nor bad. It's neutral, right? But it's how we as humans choose to use it” suggests that digital tools are neutral, that they are taken up by humans and that the way in which they are used determines the value of the tool. A hammer is good when it is used to build a house, and bad when it is used to hurt someone. In contrast, the statement: “As soon as you start to use any tool, then it affects the interaction” suggests that use defines specific realities – that it’s difficult to use a hammer for anything other than hitting things. This epistemological uncertainty sits at the heart of the community’s decision-making process, especially as participants try to support children in their engagement with increasingly sophisticated and persuasive technologies. While a hammer and a computer are both tools that extend sensory capabilities, the computer’s effect size is orders of magnitude greater than a hammer.

Key Considerations in Determining Appropriate Digital Device Use for Pre-Adolescents and Adolescents.

When asked *why* they felt there should be limits around device use for pre-adolescents and adolescents, participants referred to healthy development, screen-time, addiction, and acknowledged the need to balance the benefits of tool use with the dangers that can potentially accompany them.

Developmentally Oriented Decision-Making.

When justifying the delay of technology use, participants often pointed towards developmentally situated issues, especially those connected to physical, emotional, and neurological development. This developmental lens includes considerations eye and hand development, healthy activity levels, movement, and play. The importance of active movement

in a developing young person was frequently acknowledged – that sitting still at a screen (being a "computer potato") disengages children from their bodies at a time where they need movement to develop their coordination and neural pathways. One teacher pointed out that foveal vision (the ability to zero in on a detailed object which is necessary for reading) is far less developed before the ages of eight or nine.[39] Participants also referenced topics in cognitive development, and socio-emotional well-being, especially the development of self-concept (self-regulation and self-confidence), social skills, empathy, and resilience. Overall, participants seemed to "look at the stage of development, look at what interaction with the technology is going to do - and make a decision based on that".

One parent provided a comprehensive explanation of her family's decision not only to limit screen time in the home, but to switch their kids from public school to a Waldorf school because of the increase in ICT integration taking place. She spoke to her own background in education, child development, and pedagogy, and felt her decision, rooted in both research and experience, would serve the healthy development of her children:

> We limited their television viewing, we didn't give our kids video games and laptops and things that the other kids were doing. And all for a good reason, because I knew it would interfere with their creativity, their imagination, their social skills, and just the development of their brain. And I found myself getting into conversations with other parents about this. And they would say to me, "They're going to get exposed to video games at schools". And I'm like, "Well, not now that we pulled them out of [public]

[39] I had never heard of this before. For reference, see Doron, R., Lev, M., Wygnanski-Jaffe, T., Moroz, I., & Polat, U. (2020). Development of global visual processing: From the retina to the perceptive field. *PLOS ONE, 15*(8), e0238246. https://doi.org/10.1371/journal.pone.0238246

> school". And they thought, "They're not going to be ready for 21st century, they're not going to know how to use it". And I'm like, "That's crazy. They're probably going to be better and more adept at it than your kids". But try to explain that to somebody who hasn't - I've spent my life working with young kids. So I started working with kids when I was 16 and I've been teaching for over 30 years. So I know what I'm talking about just from day-to-day interactions with children. So the research is there. And the funny thing is research is there and we know it's there. But people are choosing to ignore it.

This perspective highlights many of the key perceptions delayed technology outcomes: that it provides space for the development of key 21st century skills, such as a creativity and emotional intelligence, that it is linked to healthier development of the brain, that waiting will make children *better* users of the tools later on, and that there is research and experience to back up their beliefs.

Participants also acknowledged that as students move from pre-adolescence to adolescence, they are more empowered to engage critically with the choice themselves. The decision to wait is in this sense a decision to *wait for the student* to become a more capable participant in the decision-making process. One parent commented she's happy they waited for cellphone access until Grade 8 because her son is "in a better position to make the right choices". Teachers pointed out that even high school struggle to meaningfully reflect on their own device use until as late as Grade 12.

Screen Time Adds Up.

In an explanation of her choice to limit digital device use at home, one parent spoke to the challenge of realistically accounting for screen time exposure with respect to pediatric guidelines:

> Let's just say I had no iPads, and no TV, and no computers, and I just had my phone, and I showed them a video of something that I saw, or we want to FaceTime my parents for half an hour. Young children are getting half an hour to 45 minutes a day, just through exposure to their parents. And so with that in mind, I'm always gonna keep my screentime limits, maybe like a little bit less than even what the mainstream people would be advising. So [if they recommend an hour a day] I'm like, my kids already five minutes here and five minutes here of me flipping through Instagram ... it just all adds up. My oldest who has homework and he has to research things and be on a screen for typing up his essay and everything like that, it's not the same as like vegging out on YouTube, but it's still screentime. So I think we're just majorly screen saturated as a society in general. So if they can have as little as possible at school, I always feel good about it.

This awareness of "second-hand screentime" stands out, as does the inclusion of school-related screen time in an overall calculus. For this family, the screen-free school day is appreciated both as an instructional choice and a complement to home life. Teachers expressed the same consideration:

> Things are changing for us. And we're doing the best we can and we may not be doing it right. And maybe the answer is to remove even more technology because they're engaging with it so much. But right now it feels like the right thing to do is to do both.

Both parents and teachers adjust their practice and rules based on their perception of what's happening outside of their own practice, suggesting that the "whole school day" approach to technology extends into the home sphere, as well.

What's Happening 'Out There'.

While the participants frequently rely on their own research, experience, and intuition in determining appropriate practice, that perspective is also impacted by that is happening outside of the activity system.

Meeting The Needs Of Post-Secondary With Digital Tools.

One parent commented: "You don't want kids like, 'Oh, I've never seen a computer in school'. And then they arrive at university, right? We do need to prepare them." Teachers and parents cited digital citizenship and online research skills as important, and while they acknowledged the need for foundational skills in word processing, typing, and presentation skills, they pointed out that many more specific technology-skillsets would be out of date within the next ten years.

Addiction.

Several participants referred to examples of addiction they've witnessed in their children's peers (from other schools). They acknowledged that managing screen-time at home can be particularly challenging for families in public school because so much of the homework experience requires a computer, making it difficult for parents to demarcate instructional and recreational use. Because the families at the school limit technology use in the home, and the school limits technology required for homework, they are able to limit recreational screen time more easily:

> My sister's two kids are addicted - beyond, beyond repair […] their only respite for no electronics is when they came to my house. And when I go to their house, they're all locked in their own rooms, doors shut, they have their devices in their bedroom at night. The older one doesn't sleep, she's up till unbelievable hours. And I always say to my

> sister, like, ‘They can't have it in their room. Take it away’, and she's like, ‘It's too late. It's too late. Or if I do that, I'll have a war, all their friends have it, this is how they communicate with everyone. This is how they get online for school. I can't, they need it’. There's a million reasons why she can't do anything. She's helpless.

This underscores the ways in which Waldorf families understand their own practice in contrast to that of other families and how they use the experiences of other families to support decision-making for rules and restrictions.

Participants also explained various examples of what they felt was “inappropriate” use of instructional technologies in public schools, such as the use of YouTube videos in class instead of a teacher reading aloud in early grades or use of iPads to support math and English learning in elementary school. While they acknowledged that the teachers using these tools likely do so because they think it is more engaging for the students, they maintain that it is the person-to-person interaction which makes Waldorf so effective, especially for students in elementary and middle school. When cellphones, Promethean boards, tablets, and computers supplant human-to-human connection in the classroom, that is not appropriate use.

Digital Devices and the Web 3.0.

Many of the participants’ views on technology coalesced into the following perspective: As algorithmic products facilitating engagement with Web 3.0, digital devices engender a host of threats to students’ wellbeing. Participants spoke to challenges with distraction, attention, time perception, and instant gratification, and the ways in which device use can condition these factors, especially in young people. Participants were concerned about polarized thinking and radicalization in online spheres, the ways in which information silos can restrict meaningful dialogue between people with different perspectives, and how these structures reify politicized

tensions in citizens. Reference to adrenal stress, sleep problems, anxiety, depression, and addiction emerged as threats to health which warranted restrictions. They expressed concern over the ways in which contemporary software design taps into dopamine responses and conditions users to engage for longer periods of time. One family summarized the conversations they have with their children about it after years of researching the impacts:

> Look - these things are designed, especially any games and whatever apps, the businesses make more money when you spend more time on it. And they use psychologists and they learn how the brain works and the chemicals in the brain and dopamine hits neuro-epinephrine and it is designed to be addictive. And people develop physiological addictions of this stuff […] Be mindful. They're awesome. And they're terrible at the same time. And so let's maximize the awesome and minimize the terrible.

Theme: Finding the Balance.

In this way, participants are trying to find the balance between providing avenues of use that allow students to benefit and learn from digital tools, while insulating them from the negative effects. While this decision-making process is understood to be dynamic and ongoing, in its current formulation participants are limiting exposure until middle school, gradually expanding access with the beginning of adolescence, and increasing technology use in the high school when these tools can safely contribute to in-class practice and ensure students are well-prepared for life after TWS.

In Summary.

Participants engage with contemporary research, especially within the field of neuroscience, determining appropriate use based on research findings, lived experience, and the realities of life outside of the Waldorf bubble. Intuition is a critical component in this decision-

making process, much as it is a foundational component of the pedagogical approach. Despite the threats identified to digital device use at all ages, appropriate use is determined by a question of use, content, and context, and understood along a developmental continuum.

What Objectives Are Met by Delaying Technology Use?

These things are amazing tools. And they're also very much a double-edged sword. And you know, we want to manage THESE, not these manage US. And we learn so powerfully from experience, right? And that's part of what I love about Waldorf: the tactile, interdisciplinary, experiential, reverential approach to learning and life. It's just so beautiful. And so I'm like, 'yeah, there's no shortage of this stuff [digital devices] around them anyway. They'll be fine'.

The objectives met by delaying technology use fit into two categories: ensuring the school day is one of active, effective learning and development, and that students do not graduate as 'mere users' of technology. Given the threats to development and health outlined in the decision-making process, teachers and parents are keen to wait until students are in middle school to introduce digital technologies in the classroom; not only because of what they bring to the classroom but because of what they take away. Notably, this slow-paced integration is not unique to digital tools: the school introduces other technologies at a gradual, developmentally-oriented pace, even technologies as ubiquitous as reading. The delayed approach to technology use ensures they are integrated in ways that facilitate active, creative learning, social connection, and enhance skill development in students, rather than supplant it.

There Are Only So Many Hours in a School Day.

Just as parents are concerned about the number of hours in a day that students are engaged with screens, so too are they considering the best ways to allocate the finite number of

hours in a school day: “If you introduce one thing, it means that something else has got to be taken away. And so with that in mind, one of the parts that I love about their education is that they're slow to introduce the tech in the classrooms.”

Teachers and parents agreed that teaching specific digital skills such as coding in a particular language is “a waste of time”. They believe that the school day should focus on foundational academics, in addition to activities which support healthy development. In the case of coding, teachers pointed out that a strong understanding of math concepts provides a rock-solid baseline for any coding a student might later want to pursue. One parent suggested knitting (as a binary system) provides an age-appropriate offline introduction to coding, functioning as a ‘pre-digital-literacy’ skill.

Teachers also see the screen-free day as a way to offer breathing space from device use at home, that if they “don't have access to it in class it is, in and of itself, moderating their use”. The faculty have regular conversations about how to help students with exposure to life online: “What is the antidote for this part of their life?’ It's not where we can say it's healthy to just remove it. It's ‘How do we counterbalance it?” Teachers highlighted the need to offset device use with other activities, such as playing outdoors and going for walks, playing with friends, engaging with hobbies, and doing things in nature. They also commented on the need for slow, effortful learning activities to counterbalance the immediate gratification present in life online and try to use course design/structure to draw students into the pleasurable experience of anticipation and curiosity.

One teacher pointed out that life online can be a barrier to students’ development of self-knowledge, and a potential threat to self-actualization and freedom:

> Our goal is to send them out in freedom. But in order for them to be free, they need to be able to know themselves. And if they're constantly getting input, they don't have time to just get to know where does that inner silence come from, the quiet contemplation, the processing, all those things, so that they can end up being free - they're not free, they're tethered. To all of it. I think it's so important for the school day, which is such a significant part of the child's day, to protect that space.

Supporting Developmental Health.

When asked to explain the benefit of delaying technology integration in the classroom, one STEM teacher explained:

> I do like the idea of our lower school children not using calculators. There has been a lot of research done on how memory works and much of it is through writing and seeing and writing and seeing again. And practice has to be there. Developmentally appropriate to me means that accessing what's in the noggin', in the developing years, is much more important than accessing information that's available.

Here, learning is oriented towards developing what's inside, rather than accessing what's outside, and improved cognitive function is impacted by the kind of repetition and practice afforded by mental math and paper-based calculations. This comment about the relationship between pen to paper and memory was echoed again and again by teachers at the school, and parallels assertions that getting on the computer too soon shortchanges grammar, spelling, and handwriting skill development. Proper physical development of the body (especially the hands and the eyes), socio-emotional outcomes of peer and teacher interactions, and advanced states of cognitive development were all common reasons given to support the decision to wait until middle school to introduce ICT use in the classroom; these tools can get in the way of movement

linked to physical development, interactions that support socio-emotional learning, and the labour intensive practice that improves cognitive development. Once those wheels are in motion, so to speak, the level of technology present in the classroom can increase without having a negative effect. This is why they start slowly in middle school. In accordance with the Waldorf picture of development, critical shifts are happening in the move from pre-adolescence to adolescence. The physical development of the body is less harmed by longer-periods of motion-less computer time and many of the cognitive skill foundations in language and math are in place; the kinds of abstract and hypothetical thinking supported by computer interactions are increasingly possible and useful in the transition to adolescence, and schoolwork is complex enough that digital tools can play a role in stretching and supporting learning.

Improved Learning Outcomes.

The Waldorf understanding of pre-adolescent learning environments demands an active, tactile,[40] experiential, and emotionally engaging classroom experience, one which many teachers feel digital tools cannot provide.

Experiential learning and knowledge creation.

At TWS, learning from experiences is a core pedagogical approach. In support of this goal, storytelling is the foundation of learning in the Lower School. This is storytelling as a fundamentally experiential and imaginative medium, not as a form of entertainment. Teachers believe students should generate their own mental pictures in the pre-adolescent years and that

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[40] This doesn't just mean that students in Lower School do a lot of gym class: learning activities often take place outside or take the form of live demonstrations. They are supported by physical games and movement, with math classes "climbing up and down from their desks" . Even observations of the library facilities, typically a space for quiet reflection, found jump ropes, bean bags, and three baskets full of different kinds of balls ready to support remedial learning activities.

those inner representations of their own understanding form the basis for later abilities in critical thinking and judgment. Shortchanging those moments with screen-based learning supplants the young learner's ability to imagine for themselves, the ripple effect of which impacts adult capacities in critical thinking and judgement. In high school, direct exposure to experiments, live demonstrations and other instructional strategies encourage students to deploy those critical thinking skills, and integrate knowledge in a way that is meaningful and memorable for them. When digital tools support those aims, they are included in classroom practice, but when easy access acts as a barrier to translating information into knowledge, they are not.

Generally speaking, participants felt that younger students are not able to meaningfully engage with work mediated through a screen, that ICT in the classroom does not engage learners, especially with respect to the kind of active and internal work they are trying to produce for this age group, and that screen-based learning doesn't feed a student's imagination or fuel their motivation for learning. They also pointed to the lack of self-regulation around inappropriate use, especially for young learners who are still developing self-regulation capacities. Parents agree that ICT use in the classroom can be a distraction for students, one which impacts on their ability to meaningfully engage with material and reflect on how they relate to it.

Engagement.

Since a commonly cited benefit of ICT use *is* improved engagement, I was curious about what the engagement levels in a screen-free classroom would be. For the Grade 4 and 6 classes, engagement was high. One observation note recorded: "SO MANY HANDS UP! Jumping, waving, almost falling off of their chairs, vibrating with trying to answer" and this was not unusual. Body language, gaze, and participation rates indicated that students were consistently engaged in learning activities, throughout the school day. With the adolescent groups,

engagement was more varied, and the presence of digital devices in learning did not seem to determine higher or lower levels of engagement as much as specific use cases. Interactive activities, such as the University of Colorado's web-based simulation "John Travoltage"[41] demonstrated high engagement, similar to in-person lab experiments. The lowest levels of engagement recorded were those when the teaching method used a visual display (either a projector screen or a whiteboard) for classical, "sage on a stage" style learning. When students were asked to listen and take notes alongside elevated teacher-talk-time, eyes drifted and body language slumped. Notably, when laptops were open for note-taking in those situations, distracted behaviour such as working on other assignments was observed.[42]

Socio-Emotional Health.

Given the emphasis on affective engagement for younger students and "the social curriculum" encouraged for all ages, the screen-free school day is also understood as a way to promote social and emotional wellbeing. One teacher stated simply: "You can't teach social emotional health through an iPad."

Other Examples of Delayed Technology Integration.

Perhaps the most famous "delay" in technology integration for Waldorf schools is that of reading. Students at TWS are not expected to read in class until Grade 3. When I asked about this delay, teachers were quick to point out that students are building a foundation for reading ability from kindergarten, one that allows them to pick it up quickly, and that waiting until they are

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[41] https://phet.colorado.edu/en/simulations/john-travoltage

[42] The most off-task behaviour I saw was during one such note-taking period. I thought I had caught a student hot-spotting her computer with an escaped phone to get on the internet and do some off-task browsing while bored during her class. Upon closer examination, however, it turned out she did not have access to the internet and had instead pre-loaded a webpage (an interview with Malala no less!) for research for another class.

"developmentally reading" means they require limited support. One middle school teacher commented:

> Was I really happy when they all came to Grade 3, having become readers over the summer? Yes. I never taught them how to read. They all just learned how to read. Because once they developed, and we waited for their development to happen, it just came easy. It came naturally.

For parents, the waiting game carries more anxiety, especially given the benchmarks around delayed literacy in the province and the perspectives of significant others outside of the activity system. But as one parent acknowledged:

> By giving them all these different sensory experiences, you actually make a deeper connection to literacy. I always try and make a distinction between literacy and the skill of reading. And that sort of literacy is more about your relationship to a story and your ability to kind of have a picture, an inner picture of the story. And to make it your own.

The school's approach to reading is less oriented towards the "skill" and more about the skill in an overall trajectory of literacy development – one students can then draw upon in a variety of contexts, such as foreign language learning and new media literacies. Observations indicated that students in Grade 4 had already surpassed standard benchmarks for reading ability. Sitting in on their Language Arts lesson, I observed as they started Louise Erdrich's *The BirchBark House* (which is rated for Grades 4 and up). After the teacher read the prologue aloud, students shared words they didn't know the meaning of (Smallpox, Trilling, Grimaced, Pitiful, Makazins) and worked together as a class to figure them out. Then, the teacher invited students to read one by one aloud to the group. Many hands went up and they read through the first chapter with relative ease.

Simple to Complex Technologies.

Just as students experience a developmental trajectory in writing implements (moving from block to stick crayons, and then coloured pencils to calligraphy pens) as the bones of the hand, fine motor skills, and dexterity develops over the course of Lower School education, so too is the shift from simple to complex tools echoed in the fine arts and technical arts courses. In art classes, for example, they work through simple watercolour painting and sketching first but by Grade 10, tablets are permitted for digital artwork. One teacher explained: "Drawing on paper is like learning music and the digital art is like jazz", another medium with its own, perhaps more complex challenges. In these three examples, students build early "literacy skills" first and that prepares them for later success with increasingly complex versions of the form.

Theme: The Right Thing at The Right Time.

I wondered whether or not parents felt anxiety about this delay in technology use. As one parent suggested:

> The kids are not going to miss anything, by not being online. In fact, it can be very, very distracting. So that's what I'm seeing in the public school, where they're getting these lessons - some of them are impressive, and the things that they're doing and the PowerPoint presentations they're putting together, and yeah, they're doing a lot of stuff that our kids are not doing yet. But our kids are getting a foundational ... like, in place of that time, they're learning other things that are going to serve them. So when they go out and now they need to research – instead of being in Grade 3 and it's hard to teach a Grade 3 child these important things – now they're in Grade 8, and they have to do the research and they're at a completely different emotional level to be able to understand the lessons so there won't be a gap.

Underscoring this approach to slow integration is the implicit belief that the level of difficulty present in a task or tool should meet the child where they are, encouraging them to improve and develop but not overwhelming them with complexity or encouraging distraction. This isn't done out of a desire to capitulate to weakness, but rather as a tried-and-true method for producing strength and increased capacity. By waiting until students are ready, that "readiness" acts as a powerful motivator and spark for learning: "If it's the right time AND they're being stretched, they grow in confidence and resilience in a way that they appear not to when there are crutches in place too early – they lose the ability to self-motivate and push themselves further."

Tension: What to Do When You've Found The Right Time – transitioning from Middle School to High School.

While most participants seem to agree that middle school is "the right time", the diversity of practice due to the relative independence of Lower School and High School have resulted in an unsteady transition for students from Lower School to High school, and a gap persists with when and how digital skills are really taught, indicating an unclear division of labour. This gap may also be linked to the current gap in the organizational structure, in which the Pedagogical Chair is also fulfilling the role of School Administrator. Parents noted that, especially during the pandemic, there have been instances where online research/typing skills are being asked of students before they are being taught. While the CyberCivics curriculum directly addresses many of the core concepts of digital literacies, it is not explicitly oriented towards the "hard skills", such as typing, word processing, LMS access, and more. Teachers themselves spoke directly to this issue:

> I think that that's something as a faculty we're realizing. And so now we're kind of going through and saying, "Okay, we're getting students in Grade 8. And so what does that

> transition into Grade 9 look like? We can't assume that they know how to do all of these things" […] And so we're really trying to be explicit in breaking down, as a whole faculty, if you're teaching those first three main lessons, the teachers are kind of holding them differently in Grade 9 as this transition into those skill sets.

Notably, this tension extends beyond the teaching of digital skills. In some cases, HS specialist teachers in STEM curriculum subjects have started to teach in middle school classes to ensure the transition to high school math and sciences classes is smooth. When I asked middle school teachers what they understand of their role in aiding this transition with respect to something like online research skills, they acknowledged there is no standard given to them from High School teachers.

Tension: Digital Fluency Is Intuitive or Instructed?

Observations of technology use in the high school classroom suggested students were able to effectively use digital solutions. Classroom artifacts such as projects, the school's yearbooks, digital art, and more commonplace examples such as essay formatting and data presentations underscored a level of digital literacy. There were no delays observed due to teachers teaching technology or of students unable to participate due to digital illiteracy. Despite the slower approach, students are making it to Grade 11 and 12 as competent users of 21st century tools.

Conversations with teachers in High School and Lower School conflicted on *how much* these digital skills need to be taught, however. Some feel software and systems are "designed to be intuitive" and "self-explanatory" and require little instruction for adolescents to pick up, but high school teachers pointed out there are some students for whom digital fluency does not come easily, and "the only way that they learn how is by explicitly being taught". Basic skills such as

making presentations for their classes, typing notes, organizing files, and using the portal and electronic calendar were all highlighted, and many of them are covered directly in the Grade Nine Learning Strategies class, as a result.[43] When I pressed further as to whether or not these struggling students were those whose parents restricted technology use at home, one high school advisor clarified that they are students who have long had access to technology at home, but that "they've only ever used technology as an entertainment source. They've never used it as a tool". Availability alone does not determine fluency, even access from an early age. To further her point, the teacher contrasted a high school student with no televisions or cellphones present in their home:

> That student is the most able-bodied person here. Technologically, as well as physically, as well as intellectually, as well as socially, as well as emotionally. It is a fallacy [that you need the computer exposure]. It is a fallacy. She knows how to learn … she oftentimes doesn't research things at home, she actually stays after school here to do it [in the computer lab]. And gets all of her work done. All of it. She's sitting at a 99% average, in all her courses in Grade 11.

Calculators and 3D Printers: The Value of Expediency and the Issue with Black Boxes.

Assessing the delayed use of digital technologies, such as calculators, computers, and 3D printers, revealed two different perceptions of the timesaving power of technology. In some cases, these tools improve learning objectives by speeding up complex operations but in others, speed actually undermines the learning goals.

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[43] Notably, descriptions of these students included reference to executive function challenges, suggesting an overlap that is beyond the scope of analysis.

For example, calculator use is intentionally delayed at TWS. Math classes observed at the Grade 6 level showed no sign of calculators in the classroom, and while they were present in Grade 8, use was linked to specific instructional needs, rather than being acceptable throughout the class. In one Grade 8 math class, students asked to get out their calculators to solve a bonus word problem on terabyte storage (they needed to calculate 1 million divided by eight). The teacher responded amiably, “No, come on … what is 100 / 8?” and scaffolded the students through the mental math. No graphing calculators were used for the Grade 10 math classes, as students drew out their graphs neatly and quickly by hand. Even in Grade 12 math classes, I witnessed the teacher encouraging students to work without a calculator, asking the group “Have we all become very calculator dependent?” when they were slow on the mental math, and urging them to work through probability problem-sets on paper first, introducing calculators only when the calculations increased dramatically. Running through all of these examples is the underlying preference that students rely on their own problem-solving power, rather than exporting the problem to the machine – and that doing so can create a ‘dependency’.

When I asked about the absence of graphing calculators, one of the math teachers walked me through their overall approach:

> So in the Grade 9 Geometry Main Lesson right now, I just had them find the four centers of the triangle after using basic constructions and using only a compass and a straight edge, ‘Let's only use what Euclid had available to him and see how far we can get’. And then I had them bring their own devices and download GeoGebra and said, "Okay, so now we're going to explore it further" and had them use the software to put all four centers on a triangle, and then figure out that there are three of them that will be co-linear all the time. And that's something that if we were to try and do that by hand, it would take

> forever. Being able to know what the constructions are and then take them to the technology and say, "Okay, let's use the technology as a tool to then drag around all of those vertices and see what happens" […] In Grade 10, now we know how to graph parabolas, backwards and forwards. Let's see what happens to the graph of a parabola when I change this one parameter. So it just gives that immediate tool to be able to see what the effects of changes are. And Grade 11 and 12 would be similar, and in Grade 12, I'll have them do a graphing software assignment where they get to choose the design or artwork of their choice to create using graphing software and layering functions. And so some of them will Google how to make cool things in Desmos and others will mess around with things, others will put an image underneath and then start layering all of their different functions.

Here, digital learning tools are understood to be beneficial when they enrich a student's existing skillset: when they are used for "efficiency, expediency, experimentation, and extending". Students are encouraged to use digital resources such as GeoGebra and Desmos, and to find inspiration on the internet to enhance their creative output. Again, this attention to limited and intentional use of learning technologies persists, even throughout High School STEM learning, where they are used to support learning and creativity.

In the Grade 12 Physics classes, low-tech learning dominated. The teacher consistently used practical examples and experiments to demonstrate complex math concepts with students, and calculators were rarely engaged. After one low-tech demonstration (using water in a cup), the teacher acknowledged that he could have used accelerometers but chose not to in an effort to "empower" the students. He believes that giving the work over to the machine creates a black box around the math and the learning, turning the students into technicians who merely record

inputs and outputs. By keeping it low-tech, they are implicated at every stage of the problem-solving process: this enriches the experience of the experiment, expands their understanding of the math behind it and challenges their cognitive processing, all of which directly impact on learning. He explained he uses low-tech to get to high-tech and believes they need low-tech to slow down and develop the skill first. In this way, the slow technology approach extends not just across ages at TWS but also across courses. If more complex tools are appropriate for the developmental health of older students, even then there is benefit in waiting until they have a foundational understanding of a new concept before introducing a time-saving and problem-solving device. While it can lead to a quicker solution, the solution is not really what is at stake; this program is fundamentally oriented towards supporting a developing intelligence, skillset, and learning process in students and the experiments, problem sets, and assignments are all vehicles to reach those goals, not ends in and of themselves.

In the Technology Design Main Lesson classes observed, the teacher pointed out to me that many of the houses could have been built using the 3D printer and that one student had even asked to design the house herself in AutoCAD and 3D print it. While students are permitted to use the 3D printer, the teacher felt that it did not serve the lesson objectives: he wanted them to build a model that accounts for “light and life” and that the printer “flattens the work”. Furthermore, the project is designed in part to help students to challenge their will forces as they work with a variety of simple tools to solve the complex problems that emerge over the course of this multi-week project – expediency undermines that goal. In this way, the project underscores one of the neglected capacities in design thinking: feeling comfortable with not having the right answer right away. This is echoed in the teacher’s approach to answering questions: they are less straightforward answers and more signposts that indicate a new direction and encourage

perseverance. Learning like this can be slow going – it makes demands on the students' will forces and emotional strength to persevere through situated, complex problem solving. Rejecting the 3D printer implies there is a cognitive, conative, and affective loss in expediency; that using technology makes things easier in the short term but can take something away in the long term.

Because the faculty is able to work together to build a whole-day curricular experience for students, the changing face of expediency is balanced between classes and instructors. Not every class brings in quick solutions, and not every class taxes willpower and problem-solving, but each student's capacities in thinking, feeling, and willing are developed each day. This emphasis on the benefit of the delay echoes the theme of stretching and supporting identified earlier – that when introduced too early, a complex tool acts as a crutch and carries too much of the cognitive, conative, and affective load of learning.

Theme: Using Vs Understanding.

"Waldorf education is not just about how to use things. It's about how to understand how things work."

Practices and perspectives evidenced a conceptual contrast in states of "using" and "understanding", one which parallels the earlier distinction between reading and literacy. As one administrator phrased it: "Anyone can be a user of tech, right? Our aim is something far deeper. "Do you understand it?" "Are you going to be the developer of the next app? Or are you just going to be the consumer?" The preference for understanding over and against merely using is not uncommon in educational contexts, as it implies a deeper level of knowledge, fluency, and efficacy as a result. At TWS, however, teachers believe that understanding of technology should *precede* use. Moreover, participants believe that the children's abilities with digital technologies

are actually advantaged by waiting until they can approach them from a place of understanding rather than simple use:

> We are not anti-technology, and certainly our experience has not been that they have been disadvantaged in any way. If you ask our Grade 7 kids, how many of them can code and how many of the Grade 7 kids in another school can code then maybe, that metric is not going to look like it's working in our favor. But if you ask our Grade 10 kids how much they know and you compare that to even someone that has been coding for five years, usually our kids know more. Because they're understanding how it works. And not just THAT it works.

In the ICT context, this delay manifests in course delivery of CyberCivics before bringing digital devices into the regular school day: students build pre-literacies of appropriate use through the three-step CyberCivics program, where they study Digital Citizenship, Digital Literacy, and Media Literacy education through digitally-mediated and offline learning activities. One teacher pointed out that with CyberCivics, “one of the first lessons is actually taking apart a computer. So it's like before you use it, let's find out what it actually is”. This same emphasis on understanding is echoed in the Computers Main Lesson:

> I want everyone to understand how a computer works, so what I want them to know is sort of the history of technology, and then also to create a little computer. So they are given a little solderless breadboard. And they start with a simple circuit of making a light turn on and then they understand that the light on is a one and off is zero, and then that associates binary and then they start to figure out how to do math on that. So then you have to come up with all these logic gates and by the end, you create like an adder that

adds one plus one on their board. It takes about three weeks. It's pretty challenging, but it's a lot of fun. So then they understand how a computer works.

The decision to introduce CyberCivics before bringing computers into the classroom and to highlight the history of information technology, underscores the idea that introducing a tool before it can be understood puts the learner at a disadvantage. In this way, studying CyberCivics first and then getting into the Computers Main Lesson mirrors the journey from pre-literacy to reading: students build the skills, competencies, and understanding to support their engagement with technology at the right time in their development.

Tension: Who Is Using Who When Use Precedes Understanding?

In our discussions of computer-mediated learning, a teacher who had studied in Germany pointed out to me that the way to say "use the computer" in German is "computer bedienen", which literally translates as "to serve the computer". He suggested that to effectively use these machines, we have to think like them – that something of the essence of technology must be taken up by us when we use it. A later interviewee made the following analogy: Try and create a sculpture with a chainsaw. Unless you are a very skilled sculptor who has developed their capacity to work with this tool, the sculpture will look like you did it with a chainsaw. He suggested that the 'will' of the tool can move through us if we are not skilled or developed enough to bring our own thinking, feeling, and willing ("I") to bear upon it – that the chainsaw extends into us if we do not bring our "I" to the very tip of it. As such, a Grade 12 student who has worked through the vertical curriculum and is approaching the apotheosis of their "I" development is more prepared to positively engage with a complex tool than a Grade 4 student is. Advanced development and understanding means that they can orient the technology to serve their interest, rather than the other way around. If a complex digital technology can present what

looks like freedom, it does so while dictating specific ways of thinking and acting, especially to a vulnerable mind. Given that the goal of the Waldorf system is always oriented towards freedom, this consideration of the limiting effect of technology use is aligned with the pedagogical foundation.

While these ideas about the 'actions' or 'will' of technology are well-established within the broader literature of AWNSA publications around technology use, they did not emerge in many of the discussions with teachers and parents at TWS. This echoes the uncertainty around the "neutrality" of technology in the community's epistemological positioning, suggesting that the school's understanding of the nature of technology may be changing alongside its increasing use.

In Summary.

Given the presence of digital tools in students' lives, parents and teachers are keen to limit their use during the school day and save time for more important learning activities, such as engaged and active experiential learning, and socio-emotional health. This technology-deferred approach is not new, and similar patterns of perspective and practice exist with respect to reading and other technologies. Furthermore, slow technology use extends beyond a simple age-appropriate measure and into consideration of classroom activities, as teachers evaluate ways to use learning technologies to extend and expand learning outcomes, questioning whether expediency is always the goal when trying to serve the development of thinking, willing, and feeling forces and the "I". Members of the community believe that this delayed approach will ultimately serve students, shifting them from being users of technology to masters through increased understanding.

How Does a "Developmentally Oriented Instructional Experience" Build 21st Competencies and Develop Digital Literacies In Students?

> *And if we are building a solid foundation, in their hands, heart and head, if we are building capacity - their ability to use their hands, their ability to use and really develop those fine motor skills, develop these cross pathways in the brain, develop a healthy reward mechanism for their minds and their neurotransmitters to be able to settle in and not have this immediate gratification – then they're gonna learn these skills.*

At TWS, teachers and parents believe that the hours of school time devoted to healthy development provides a foundation for students on which they can meet the challenges of 21st century skills. While much of this case study has already highlighted evidence of these competencies in learning activities at the school, especially the development of emotional intelligence and resilience, let's examine practices with respect to Digital Citizenship and Media Literacy, and examples of key competencies highlighted by the 4Cs framework: Creativity and Innovation, Critical Thinking and Problem Solving, and Communication and Collaboration.

Digital Citizenship.

Students address concepts of digital citizenship in Grade 6 with Level One of the CyberCivics curriculum, which teaches students how to be "ethical, safe, and productive digital citizens" by examining the "norms of appropriate and responsible technology use". The course starts with an inquiry into the historical role of technology in societies and moves through an analysis of the use of digital tools today. Students study the principles of citizenship, digital footprints, ethical action online, cyberbullying, and online privacy.

While the idea of "digital citizenship" is only introduced in Grade 6 (when students are more able to consider the hypothetical impact of their actions at a distance on others) they have

been developing their ethical "pre-literacy" since Grade 1. The school's emphasis on moral issues and empathy, through engagement with fables, fairytales, myths, and theatre, engenders a fluency with the foundations of ethical thinking:

> The curriculum all the way through has a moral component to it. [Through storytelling], they get to live vicariously in so many different states. They can be like Loki, the trickster, or like Odin, the wise one. So they can live in so many different pairs of shoes and try on different things … and by trying on so many you can kind of find where you land in all of this.

This "vicarious experience" of moral thinking allows young learners to begin to develop an internal moral compass, rather than a received set of rights and wrongs. As their moral understanding grows and develops, they require different kinds of stories:

> In Grade 2, I'd find the right fable. And it would work with the sixth graders, but not in the same way, because they're just not the same children, right? Those are simple moral stories. But in sixth grade, they need something ... I guess, in sixth grade, that they're not there anymore, they're not in that simple right or wrong.

Given this rich practice of ethical development, students in Grade 6 are well-equipped to think through issues of cyberbullying and ethical action online, to consider the subtleties of effect in a more meaningful way.

Notably, this attention to "responsible use of technology" extends beyond the Grade 6 classroom. For example, use of the school's 3D printer is open to any High School student, as long as two criteria are met: it must be used for something the student can actually design themselves in AutoCAD and not a design that they've downloaded from a website, and it has to be for a good purpose. In observed use of the 3D printer, a Grade 11 student designed a custom

piece for a building error in the picnic tables the students were constructing as part of their community service work.

Media Literacy.

Students learn about Media Literacy in Grade 8 with Level Three of the CyberCivics curriculum, which teaches critical evaluation of print and digital media. Units cover: Participatory culture, Critical thinking, Misinformation, Media Representation, Visual Literacy, Sexting, Digital Leadership, and online search skills/bibliographic management. Given the school's emphasis on literacy, students are able to meet the task of critical evaluation with strong reading comprehension skills and transferable literacy skills.

Observations of New Media Literacies in Learning Activities.

In an effort to describe the presence of foundational media literacy competencies in students and how they will be able to participate in contemporary culture, observations tracked the instances of New Media Literacies (NMLs), highlighting examples which are representative of Waldorf pedagogy, showcase developmentally appropriate technology use, or demonstrate "unplugged" use cases.

Play: The Capacity to Experiment with the Surroundings as a Form of Problem Solving.

Given Waldorf's pedagogical emphasis on play, observations occurred at every level, with greater frequency in the younger grades. Nevertheless, play was also observed at the highest level. In Grade 12 Physics, for example, students eschewed strict experimental procedures for playful experimentation. Instead of saying, "Let's observe the change of effect when tilting the cup of water at a 45-degree angle and spinning", the teacher suggested: "Try and get your classmates wet". Social and emotional interactions between students frequently demonstrated a playful orientation towards problem solving and learning, and teachers utilized games in learning

activities, such as a few hands of Poker to augment studies in mathematical probability (Grade 12) or Hangman to practice spelling and deductive reasoning (Grade 4).

Simulation: The Ability to Interpret and Construct Dynamic Models of Real-World Processes

The pedagogical emphasis on demonstration, observation, and experimentation over textbook-based learning lends itself to simulation in many ways. Students experience complex ideas through story and games, recalling and meaning-making after they've had time to process. Observations of simulations included the 2D to 3D model building in the Grade 10 Technology Design class and low-tech simulations of non-inertial frame of reference and acceleration using a toy car on the back of a trailer (Grade 12).[44]

Performance: The Ability to Adopt Alternative Identities for the Purpose of Improvisation and Discovery

The emphasis on theatre and storytelling that sits at the foundation of Waldorf pedagogy is implicitly tied to this skill, offering students a way to "try on different characters and learn about themselves". Much of the storytelling work I watched in Grade 4 class offered similar opportunities for students to "live vicariously" through the stories, to play through and process moral dilemmas at their own pace. Students at the school transition from interactions with fables and myths in primary school to a focus on biographies in middle school. This culminates in the

[44] In this example, the teacher began the demonstration by asking each student what they are drinking while driving the car. While it's a silly aside, it generates laughs and engagement – and when the car stops suddenly, the conditions being simulated are that much more meaningful/memorable simply by remembering there's cappuccino all over the inside of this little car.

"Seeds of Courage" presentations, in which they take on the identity of a particular historical figure and present their life story in character.[45]

Appropriation: The Ability to Meaningfully Sample and Remix Media Content.

At its core, Main Lesson work represents a process of appropriation. Students take what they have learned through story, demonstration, and observation, and remix it into a personalized 2D representation. Correspondingly, after working through a simulation of life, death, and rebirth that framed the philosophical approach for the Grade 12 study of Optics, the teacher asked students to integrate the elements of the discussion into a poem, a piece of art, or anything else they can create that is meaningful to them.

Multitasking: The Ability to Scan the Environment and Shift Focus onto Salient Details

The emphasis on real-world and situated learning activities support context-dependent multi-tasking activities. For the Grade 4 class, the morning begins with fast-paced game play, where students juggle social cues, rules, and physical tasks. In Grade 8, students are observed knitting and drawing while listening to the teacher lecture. In Grade 12 Biology, experimental procedures demand shifting attention to a variety of time-sensitive fluids in heated beakers.

Distributed Cognition: The Ability to Interact Meaningfully with Tools That Expand Mental Capacities.

The presence of artifact-based demonstrations and tools supports foundational interactions with cognitive tools. Interactions with analog and digital solutions in High School

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[45] A unique point of tension here: while some members of the community feel it's essential for students to engage with documentaries and engage with the lived experience of people, others feel that role play should be used to complement documentary viewing, as it gives students a chance to take up the material in a more meaningful way: "If we really want critical thinkers, we have to have empathetic thinkers. And the only way you can become empathetic is if you're walking in someone else's shoes".

math classes, such as the shift from using only a compass and a straight edge to the "extending" power of GeoGebra, highlight the use of tools to support cognitive capacities, and facilitate a metacognitive reflection on the *effects with* those tools for cognition.

Collective Intelligence: The Ability to Pool Knowledge and Compare Notes with Others toward a Common Goal.

The pedagogical approach at the school is tied directly to the development of collective intelligence. While teachers attend to the needs of students, instruction is directed to the group. Students move as a group through learning activities and work collaboratively to solve problems. Given the absence of individual quantitative assessment until High School, all are equally implicated in the problem-solving activities of the class. In every Main Lessons observed, students dialogue with the teacher to recall learning or discuss new concepts, building on each other's contributions, and developing fluency for collaboration. Students are often permitted to sit together in small groups during individual work periods, and they brainstorm solutions to problems together.

Judgment: The Ability to Evaluate the Reliability and Credibility of Different Information Sources.

While specific lessons within the CyberCivics curriculum address online misinformation with specific and contextualized examples, activities, and discussions, this skill also emerges more organically in class. In one conversation with a middle school teacher, they explained:

> When we studied local geography, and we were studying the First Nations people, we were doing a bunch of research. And then it just so happened that our student teacher was from one of the nations we were studying. So the students were saying, "Well, this is

what we found", she's like, “That's not true, that's not true.” So then they're like “Can we believe anything we read?" And I'm like, "What a good conversation.

The flexibility to deviate from the lesson plan allows this teacher to take advantage of a natural occurrence of judgement and to scaffold the students through a sincere inquiry.

Transmedia Navigation: The Ability to Follow the Flow of Stories and Information across Multiple Modalities.

The work of Main Lesson learning, especially the transfer of information from oral storytelling to written word to visual presentation makes this NML a daily practice for Waldorf students. Notably, the vertical curriculum (in which students return to the same concepts and contexts over the 12 year program) provides a unique opportunity for them to follow the journey of stories, how they are changed and retold in new cultural contexts. This practice provides a robust, offline foundation in media translation.

Networking: The Ability to Search for, Synthesize, and Disseminate Information.

Despite the limited use of technology for teaching and learning, participants stressed the need for students to be able to use the internet effectively for online research. Building this skill is scaffolded over transition from middle school to high school. For example, I watched the Grade 6 class use mostly print based resources for their project work on Roman civilization. By Grade 8, research for the Canadian History presentations was done through the Canadian Encyclopedia online. Observations of the Grade 9 Learning Strategies class highlighted a more independent online research practice as the foundation for presentations on neurodiversity.

Negotiation: The Ability to Travel across Diverse Communities, Discerning and Respecting Multiple Perspectives, and Grasping and Following Alternative Norms.

The High School's yearly practicums (where students spend three-four weeks working on a farm, at a business, and in community service roles), in addition to the yearlong foreign exchanges in Grade 10 were on hold during the pandemic, but the emphasis on negotiation is built-in throughout. In one "Circle" observed, middle school students worked through their response to a challenge with another teacher as a group, holding the truth of their own feeling alongside openness to the perspective others (a stance modelled by the teacher). At the heart of the issue was that acceptable behaviour with their main teacher was considered unsportsmanlike by another, and students made comments such as "I'm trying to put it in his shoes, so I can see why when we do our cheers, he doesn't know why it isn't bragging" and "I think from his perspective…", indicating they are attempting to "think through" the thoughts and feelings of others.

Creativity And Innovation, Critical Thinking and Problem Solving, and Communication And Collaboration.

Observations of creativity abounded at the school. So much of the work of learning is done through active creation and project-based learning. The emphasis on Fine Arts classes such as Visual Arts and Music provide nourishment for the creative capacities of young learners and even more traditionally oriented STEM subjects demonstrated moments of creativity. At TWS, the individual student (working as part of the functional organism of the class) is implicated in the possible solution of every problem encountered. This provides support for their developing self-concept and problem solving, and consistent positive reinforcement that solutions can be found through collaboration.

The pedagogical emphasis on forming "mental pictures" as a precursor to judgement underscores later fluency with problem-solving and critical thinking. As one teacher pointed out:

> When I talk to parents about [critical thinking and problem-solving curriculum], I talk about being able to make mental pictures. If you can't picture how different outcomes might be, how can you solve your problem? So developing that from an early age, while the ability is still there, for taking advantage of what is alive and most productive at each stage of development will allow for that.

At every stage of development, students are building their capacities to be able to meet the 21st century demands of Creativity and Innovation, Critical Thinking and Problem Solving, and Communication and Collaboration.

Grade 6 – Math to Unicycling.

While spending the day with the Grade 6 class, I watched many of these developing skills in action. They spent the morning in earnest concentration and dialogue of fiscal math concepts. First, they worked together as a group to recall the lesson from the previous day. Then, they worked through the new concepts, calculating mental math back and forth, and settled into individual problem solving and bookwork to consolidate their learning. Finally, they headed down to the gym for twenty minutes of unicycle practice! Students worked in groups of three, with two supporting one and rotating out every couple of minutes. It was evidently the early days of this skill – chaotic, to say the least. The teacher was present but they offered little instruction or restriction and did not make any attempt to stop groups from unicycling into each other. Helmets were on and falls happened as they may. Later that week, in a conversation with the teacher, she commented: "It's so important at that grade level for them to trust each other. And I think it's just such a beautiful metaphor, the two supporting the middle one upright." It's easy to

dismiss an activity like unicycling as a fun add on or a motivating tool ("you only get to do unicycling if you score x on your test") but at TWS, it's neither of those things. The activity is dependent only on the self-regulation needed to remember to bring a helmet. It acts as a critical support for the physical development of balance needed at an age of lengthening limbs and changing center of gravity, a trust exercise between peers developing their socio-emotional fluency with each other, a comfort in working with others and accepting their support or recommendation, and a challenging task that demands communication and collaboration in problem-solving *how the heck to unicycle*! (I can't do it, can you tell?) Each and every one of those competencies is called up six years later in Grade 12 Physics, in a culmination of these years of practice.

Gr 12 Physics: Designing an Acceleration Experiment.

Later that week I watch the Grade 12 Physics class work through a practical demonstration. The experiment is drawn directly from their textbook ("Analyzing Uniform Circular Motion") in which a weight is affixed to one end of fishing line run through a pipette, and a rubber stopper is attached to the other end of the line. Holding the pipette, the student spins the weighted end at such a speed that maintains the same position of stopper – certain weights demanding slower or faster speeds. While the experiment is standardized, the manner in which it is conducted encourages creative problem-solving and collaboration.

The teacher provides limited structure after an initial discussion of the procedure. The students work in pairs, making suggestions, receiving feedback, and collaborating as a team. They rely on physical dexterity to spin at the correct speed – no easy task, as weights go spinning past their heads. I notice as one group struggles to get the experiment to work. While this could be treated as failure, it's clear from the students' reaction and the teacher's response that they

consider this the work of good science: trying, failing, learning, and trying again. Both teacher and students are laughing and joking over their continued struggle, comfortable in the "experimenting". There is certainly frustration and confusion but the students are undaunted. The teacher helps them interrogate the issues by modelling the correct form, asking a series of concept check questions, then stepping away, asking them to think about whether they are "in it" – if they're feeling the experiment or trying to just get to the end of the class. I note the time: they are *past* the end of the class. No one seems to have noticed. This particular team is now deep into an analysis of procedural error, engaged and determined to figure out what the issue with their experimental procedure is.

This showcases a couple of key moments in 21st century skill building. The students have a level of trust and comfort in their environment – they're not afraid to fail and they work well with their partner even in the face of failure. They're engaged by difficult problem-solving rather than put off by the challenge of it. The students demonstrate a capacity for critically analyzing what is working and what isn't, and one watches the other member of the team perform the experiment and then they switch, trying to integrate a solution to the errors they've observed. The teacher allows for the lesson outcomes to shift, recognizing the value in what they are learning even if they've run out of time to fulfill the lesson plan. He encourages them: "Just play a little bit in the realm – what's the slowest you can spin it, what's the fastest?" Notably, the patterns of engagement demonstrate communication and collaboration between peers AND with the teacher. He's positioned himself in such a way that he remains a figure of subject matter expertise but is inaccessible as a source of immediate answers to the problem. He is working through the solution as they are, scaffolding the physical, emotional, and cognitive elements of

the problem-solving task, and encouraging them to engage their thinking, feeling, and willing in playful experimentation.

Grade 6 to Grade 12 – A developmental continuum.

Because the school is oriented towards a social curriculum, effective communication and collaboration are baked in from the beginning. What emerges when looking at these two lessons side by side is the ways in which these skills are developed holistically. There is no particular moment for problem-solving, nor is there a break in the learning for communication and collaboration. They run together. This ability to work within a complex problem-solving ecosystem is supported by the cultivation of wonder, awe, and curiosity in the early educational years, strong physical, socio-emotional, and cognitive foundations, and years of situated experience with thinking, feeling, and willing. While the problem-solving complexity found in the Grade 12 classroom would be considered inappropriate for primary school students, they build the skills for success early on. Ultimately, parents and teachers hope that this developmentally oriented education gives students something to draw upon later in their life; that they are able to tap into greater reserves of empathy, resilience, and creativity for whatever endeavors they may pursue.

Tension: Communicating 21st century skillsets.

Despite the proliferation of evidence to support critical 21st century skill building, I overheard a conversation between students that highlighted a critical tension in perception. While working on their Technology Design projects and lamenting that they might not finish in time, one student commented: “My mom doesn't care, she thinks this class is a waste of time”. The other responded: “Does she only like academic classes?” The first confirmed yes, and the second followed up glibly: “Why did she send you to Waldorf?”

Although many observations of key competencies were found in exactly this project work, it's evident that parents and students don't fully recognize this. Just as Waldorf education has struggled to communicate with other school systems, TWS struggles to communicate what it is doing with its parent body: "We do these things and we do have intention. But we're not so good at naming exactly what we do in the same way that the [Toronto District School Board] curriculum does". While its possible for someone studying 21st century competencies to come into the classroom and to recognize pedagogical strategies that support it, if the parents and the students don't understand what's taking place, the students aren't able to commit to the process – and this may undermine the efficacy of these outcomes.

In Summary.

New Media Literacies and other 21st century competencies are built from a young age at TWS in screen-free learning activities. The pedagogical emphasis on play, problem-solving, creativity, collaboration, and moral development provide foundational support for these competencies offline, allowing students to call upon them for use in a variety of contexts. The classroom environment encourages effort and students are free to try, try, and try again. Although the school is providing robust support for key 21st century competencies, they are not effectively communicating this to the parent body. This may impact student buy-in at a High School level, which can undermine the efficacy of learning activities and competencies.

Updating Steiner or "Waldorf 2.0"

In an effort to spark a reaction, I would sometimes ask teachers how they understood Waldorf in the 21st century – what might constitute a Waldorf 2.0. One response encapsulated much of what I would go onto observe at the school:

> If I were to describe the 21st century education in Waldorf, it's about revamping a lot of the curriculum to not be so Eurocentric, and teach more diversity, equity, inclusion and justice. So now in Grade 11, they have this HSC course where she teaches from the perspective of Indigenous populations and people of colour. And we need a lot more of that.

Notably, the new HSC course actually replaces the Business Technology course, further highlighting the priorities at the school. While parents and teachers all agree that students need digital skills and literacies for success after Waldorf (and that learning activities and teaching practices can benefit from appropriate engagement with technology), their 21st century focus is on fostering an understanding of others and care for the world around them.

What Do Students Need for Success In The 21st Century?

When asked about the goal of Waldorf education, what teachers hoped the students would leave the school with for success, one teacher summarized many of the comments with the following statement: "A relationship with themself, relationship with people, and relationship with the land". Participants emphasized a hope for robust self-concept, critical thinking, resiliency, and intrinsic motivation in the pursuit of personally meaningful goals. They expect individuals who can stand on their own and relate to others. They value an empathetic individual who engages well with others, showing tolerance and care in the face of difference. They strive to pass on a love of learning, and care for living things, and stewardship of the natural world. In this way, 21st century Waldorf education at TWS strives to address the challenges that are amplified by technology use in this country: depression and anxiety, burnout, and group think; loneliness, discrimination, and xenophobia, and the perception that our world is disposable, an object to be used and discarded.

Summary of Findings.

At TWS, developmentally appropriate technology use facilitates competencies in creativity and innovation, problem solving, critical thinking, communication, and collaboration, and New Media Literacies for students throughout their time at the school. Learning activities build offline "pre-literacies" throughout Lower School, and teachers slowly introduce ICT mediated teaching and learning activities over the middle school years, while privileging active dialogue and person-to-person interactions. For High School students, intentional use of ICT is a normal part of teaching and learning, especially when it enhances an existing skillset or problem-solving capacity. Screen-free learning in the early years is appreciated by teachers and parents who remain concerned about the negative effects of digital devices on physical, socio-emotional, and cognitive development. These concerns emerge from their engagement with external research sources, experiences with public education, learning within the community, and personal experience and intuition. They feel a low-tech experience, both at school and in the home, is the most appropriate course of action to support the development of children as they move through pre-adolescence and into adolescence, though disagreement between adults at the school persists when it comes down to the specifics of best practices. The low-tech to high-tech transition is supported by the CyberCivics program, a three levels digital literacy education in the Middle School, but division of labour issues between the Lower School and High School faculties as a result of organizational structures undercuts the efficiency of the transition between the two. Ultimately, delayed technology use provides time for students to develop their physical, socio-emotional and cognitive skills, and the school's curriculum provides strong support for emotional intelligence, moral development, self-efficacy, and resilience. The school's "social

curriculum" is perhaps its strongest priority, as parents and teachers work together to help students become free, moral actors who care about others and the world around them.

Governing Principles for Technology Use.

Teachers should strive to find the balance between the benefits and challenges of technology use, stretching and supporting the developmental capacities of students. In order to do this, technology use should be limited and intentional, delivering efficiency, expediency, experimentation, and extending learning activities in accordance with objectives. Teachers and parents must be attentive to introducing the right thing at the right time, as this can alleviate many of the challenges that technology may engender in students. Middle school-aged children are increasingly capable of using technologies as tools and able to conceptualize responsible use of these tools, though all school-aged children struggle to self-regulate their use of digital devices. Therefore, use should be introduced slowly and with clear boundaries, and ICT can be a more regular part of learning activities in High School, especially when it is used with limiting features (such as Yondr pouches and restricted WiFi). The school day can be an "antidote" to challenges of immediate gratification, addiction, stress, etc. if it works to counterbalance their impacts through screen-free learning activities that challenge thinking, feeling, and willing, and make time for physical activity and rich socio-emotional engagement.

Chapter 5: Discussion

This section summarizes the limits of the study, avenues for further research, and recommendations for practice gleaned from the findings, and the conclusion.

Limits

Socio-Economic Status (SES)

While the Toronto Waldorf School has traditionally been made up of more diverse socio-economic status families, drawn together by shared interest in the Steiner oriented approach, the cost of living in the Greater Toronto Area is increasingly prohibitive for many of these families. Since independent schools in Ontario are not publicly funded (in contrast to most Waldorf schools worldwide), this places an additional financial burden on many families. Since research findings with respect to engagement, achievement, well-being etc., are often correlated with SES, the community is skewed towards more financially stable families who have potentially more time and resources to spend on their children. All of the families are financially able to provide support for digital devices such as laptops or tablets and do not rely on school as a key access point.

Fewer Families, Longer Interviews

The choice of the study design (one family per grade) and the focus on long interviews (most lasting at least one hour) rather than short questionnaires means that there are fewer parents and teachers interviewed. This was amplified by the ethical recruitment procedures used, which may have limited the participant pool. The families interviewed are representative of the case, with triangulation efforts in observation, document, and artifact analysis paralleling the results gathered, and providing a consistent picture across the case.

COVID Scheduling and Restrictions

The study took place during the COVID-19 pandemic. As a result, elements of the case study were not able to assess "normal functioning" of the school. This was especially evident in the scheduling and elements of the daily rhythm for students. For example, high school classrooms were re-arranged, and the scheduling for high school and lower school were dramatically different than regular programming, offering standard main lesson blocks and afternoon specialty classes, with a final two period block for "intensives". Traditionally, specialty classes run all year round, rather than rotating in these intensives, and the classes are organized to meet the natural rhythm of the student (Barnes, 1991). Timing the study alongside COVID measures interfered with representing the case in its most conventional formulation.

Community events and on-site parent involvement were also impacted by COVID measures. Changes of the season, such as Advent, are typically celebrated by the community, with parents, students, and faculty gathering together in the forum for singing and festival observances. After-school clubs were also in the process of restarting during the observation period due to COVID-mandated hiatus. While actively attended by students in the High School and supported by parents and teachers alike pre-pandemic, the Robotics Club had not returned to the schedule during observations.

Avenues For Further Research

Earlier, the review of attitudes towards digital technology in Canadian classrooms suggested three key beliefs: that education supported by digital tools is transformative, that they can amplify learning, and that this change applies not only to learning activities but also to thinking; that this integration should take place sooner, rather than later, so that students are most advantaged; that the measure of success in life is defined by market competitiveness. Analysis of

the perspectives and practices at TWS suggest that the community is not aligned with these beliefs. It is evident that the teachers and parents are more concerned with healthy development, self-concept, appreciation for nature, and respect for life than they are with 'market success'. Both parents and teachers feel strongly that earlier is not necessarily better and are keen to delay the integration of complex digital tools in the classroom until high school. They contend that despite this delay, students are capable of using these tools for a variety of typical purposes. Finally, they feel that digital tools can amplify learning as much as they can also undermine it. Notably, participants and pedagogists in the Waldorf context express mixed perspectives on digital technology's interaction with thinking. Some assert that the devices themselves are neither good nor bad, and that like most tools, the way in which it is taken up is what matters. Others question whether the use of complex digital tools has a range of effects that exceed their categorization as 'mere tools'; that interactions (especially for young learners) can, in fact, impinge on freedom of thought, dictating perceptions and perspectives, and stunting development . This is certainly an 'out-there' take, especially when contrasted with the utopian vision of ICT in schools that presents in the current zeitgeist.

This 'question' concerning the impact of technology is not a new one. In 2001, in an essay entitled "But it's only a tool!", Robertson argued that "the metaphor for information technology as a 'tool' hides its dynamics and inhibits thoughtful discussion about the appropriate role of computers in the classroom" (p. 13), that it (wrongly) suggests that the tool has no power or will of its own, that it is *neutral*. Half a century before that, Martin Heidegger made a similar observation: "we are delivered over to [technology] in the worst possible way when we regard it as something neutral; for this conception of it […] makes us utterly blind" to its essence (Heidegger, 1977, p. 4). He contends that technology's power to reshape nature has a

transformative impact on our perception of the natural world; that it shifts human beings from seeing themselves as part of the natural world to a perspective in which nature is a reserve to be used and exploited (as *bestand* or 'standing stock'). In essence, he argues that the enframing power of technology ultimately objectifies the natural world within our consciousness. While this is a bold argument, it is evident that digital technologies mediate our experience with reality and shape how we act. If schools seek to cultivate a culture of sustainability and equity, and a respect for nature and life as a significant component of 21st century education, deferring the omnipresence of digital tools to mediate that experience may in some way diminish the perpetuation of those psychological frames of objectification. More research is needed to bring these ideas from the musings of phenomenologists into conversation with educational thinkers and researchers, and a greater consideration of these questions is needed within the field of educational technology if it is truly an "ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" (Rushby & Surrey, 2016, p. 4). In this same vein, more research is needed within the field of developmentally appropriate technology use to further describe the "effects of", "effects with" and "effects through" technology use that Solomon and Perkins's (2005) framework proposes. Appeals to the transformative power of digital technologies in learning are incomplete without robust consideration of the full scope of these changes on learners.

Findings from this research highlight the ways in which TWS attends to the healthy development of pre-adolescents and adolescents, especially within the moral and social dimensions. While developmentally appropriate practice is traditionally 'over' by the age of eight, findings from contemporary neurology maintain significant development is still occurring for adolescents, especially with respect to key frontal cortex behaviours such as self-regulation,

attention, and response inhibition, and emotional and social development (Goldfus & Karny-Tagger, 2017). Observations from this case study highlighted instances in which curriculum, subject matter, teaching methods, and regulations around device use can support adolescents' health development. As a result, the findings suggest that these educational variables be evaluated from a developmentally appropriate perspective beyond early childhood education. Key 21st century competencies such as problem-solving, self-concept, and critical thinking are woven into the fabric of the curricular experience, and practice at TWS seems to represent a unified, "whole school approach" (Ohler, 201) to the moral and social development of each student – a critical component of the kind of digital citizenship needed in the modern world.

Recommendations

While there are limits to the generalizability of the findings, the following recommendations should be considered by schools outside of the Waldorf pedagogical context.

The Cost of Early Integration

Despite the emphasis on early digital literacy building that presents in the literature, there was no evidence that students at this school were disadvantaged in their digital competencies in the high school classes by delayed integration in the lower school. Given the significant budgetary issues faced by lower SES school districts in securing the money for technology spending (and the reliance on parent fundraisers to do so) (ICTC, 2021; Watkins, 2020), not to mention the significant provincial funding backlog with respect to repair (Catching Up, 2022), school districts may benefit financially by reserving digital tools for high school and/or middle school students. Results from this study provide a path to 21st century competencies, without the use of expensive ICT tools. Given the emphasis screen-free learning may have on free play, socio-emotional engagement and learning, and physically active engagement, delayed

technology integration can address both the financial and developmental costs of early technology use, without disadvantaging students later on.

21st Century Competencies: Unplugged.

Waldorf pedagogy provides unique and effective strategies for the development of key competencies, such as problem-solving, communication, and collaboration. Given their presence in 20th century classrooms, the claim that one can teach critical thinking without a computer is hardly controversial. Evidence from this study goes further, however, and indicates specific strategies for developing new media literacies, and digital and global citizenship, without the use of digital tools. Much like the school develops pre-literacy skills before introducing the technology of reading, so too do they practice pre-digital literacies before including digital technologies in the classroom. While this research is very much in its infancy, other findings such as Tsortanidou et al.'s (2022) work on computational thinking in unplugged activities at Waldorf schools are compelling. The building blocks of 21st century competencies are not dependent on digital tools, and teachers should consider offline learning activities to help students to build their digital literacies, especially when alternatives are more budget-friendly, developmentally appropriate, socially engaged, and active.

Private Property and Distraction

Engagement with cellphones is a significant barrier to learning for Ontario students. Despite the potential instructional benefits, their presence is consistently distracting for students. While the province has restricted the use of cellphones, these bans are generally ignored at the district level, leaving it up to the discretion of the teachers. This places teachers in an often-untenable position: spend the class time on behavioural management, or face litigation for withholding personal property. Anecdotal evidence from many teachers reveals they have chosen

to simply ignore cellphone use, despite the costs to engagement and learning, and the potential for cyberbullying and privacy violations (Graafland, 2018) that free-rein with these devices bring into the classroom.

The Yondr program used at the Toronto Waldorf School provides an effective solution to both of these problems. Students retain possession of their personal property for the duration of the school day and phones can be used for instructional purposes when the teacher finds it appropriate. They are unavailable as a distraction factor in class, improving engagement with the class and academic outcomes as a result. This program was motivated by the loss of informal social learning outcomes during free time (lunch, recess), and it protects socio-emotional face time and engagement for students, especially those who are more shy, neurodiverse, or English language learners. Given the significance of play, conversation, and rest for the social, psychological, cognitive, and physical wellness that is foundational for learning (RSC Task Force, 2021), we should consider the use of this or similar solutions. They provide a simple solution to the challenges of distraction, behavioural management, cyberbully, privacy, and litigation currently facing Ontario's schools and teachers.

Consider The Antidote

Many of the problems outlined, such addiction, cyberbullying, radicalization, and disinformation may be improved if schools can more rigorously engage in the developmentally oriented practices found in a Waldorf school. The idea of an "antidote" to the challenges of the digital world emerged in discussions, and it is one supported by Waldorf pedagogists more broadly. Gerwin (2018) suggests "a ratio of computer time to movement time; a ratio of computer time to mental creativity time; a ratio of virtual computer experience to lived experience needs to be calculated as children get older" (p.10). Since school time represents such

a big chunk of an adolescents' environmental context, schools bear a significant responsibility in providing experiences which can shape cognitive and socio-emotional patterning for the better, standing up to the threats posed by problematic technology use.

Support Socio-Emotional Development and Bolster Mental Health

Given the findings that emotional regulation is a key mediator between problematic smartphone use and antecedents such as boredom, stress, anxiety, neglect, etc., socio-emotional health can be an antidote to addictive behaviours (de Freitas et al., 2021; Squires et al., 2021). The more emotional regulation an adolescent has, the less likely they are for states of mental health distress to spiral into problematic smartphone use. Furthermore, given that adolescence is a key period in learning risk/reward behaviours and regulation (Goldfus & Karny-Tagger, 2017), this time period is directly implicated in the development of healthy behaviours with respect to digital technologies. The more attention that is paid to supporting strong socio-emotional development in school, the less vulnerable youth may be to addiction. With this knowledge, it's important to consider how school environments can act as support systems instead of deterrents to socio-emotional health, especially when it comes to rules around technology use.

Increase Tech-Free Time – At School and At Home.

Given the difficulty pre-adolescents and adolescents face given their developing self-regulation, consider enforcing tech breaks throughout their day. As Rosen (2017) recommends, parents will do well to help their children cultivate moments of screen-free time at home. Given the addictive relationship that many young learners have with their digital devices, it's important for them to have time to "reset" (Rosen, 2017). Taking time for "quiet time" or mindfulness practice and the need to protect moments of boredom were key ideas expressed by participants in this research, and they believe they are important for healthy adolescent life. Encouragingly, the

distractibility and anxiety of young people is not a given; it can be reduced with support from both parents and teachers (Rosen, 2017).

Given the number of hours students spend engaged with screens recreationally, teachers need to be intentional about their use of screens in the classroom, opting for socially engaged and physically active instructional moments where possible. Schools can play a significant role in helping parents and students cultivate a healthier relationship with device use, just as they have been shown to impact healthy physical activity level outcomes (Rajbhandari-Thapa et al., 2022). Talking with students about the importance of sleep-hygiene, restricting notifications, keeping a distraction-free study environment, and taking time to reset from tech use are all strategies that Rosen (2017) has found success with.

The loss of sleep due to digital device engagement is perhaps the most significant negative effect of recreational device use on school performance. This is significant because sleep is the time for memory consolidation and encoding, supporting high-level problem solving and innovation – critical 21st century competencies. In an effort to support the tech-free time at home, teachers should be cognizant of how much screen-based homework they are giving, and how much doing that homework may be directly impacting a parent's ability to meaningfully restrict tech-time at home – especially at night. The volume of homework given and the medium in which it is offered are easy ways for a student to justify extra iPad or computer time, especially when they're losing an average of five mins from every 15-minute set to distraction (Rosen, 2017). Given the average number of hours young people already spend on their devices, intentional and limited use of digital devices – even for homework or flipped classroom approaches – is critical.

Conclusion

Evidence from this research suggests new strategies for aligning developmentally appropriate practice with technology use in middle school and high school classrooms, and at home. Teachers and parents at the Toronto Waldorf School prefer to wait until students are in middle school to introduce digital technologies in the classroom; not just because of what these tools bring to the classroom but because of what they take away. Students engage with a three-year program of digital literacy education before digital tools are integrated into classroom practice, thinking through the implications of complex ethical issues such as privacy, cyberbullying, and disinformation in early adolescence as they are socio-emotionally and cognitively ready to meet the challenge. Despite the delay, students in the high school demonstrate effective and independent use of these tools for a variety of learning activities.

Key 21st century competencies such as critical thinking, problem-solving, collaboration, and creativity are encouraged by a safe, supportive, and engaging atmosphere at the school, and teachers emphasize interactive experiences and project-based learning activities, including digital technologies in middle school and high school classrooms when they can extend learning outcomes without compromising the whole-school approach to physical, social, cognitive, and moral development. While rooted in a longstanding and historical educational tradition, teachers and parents continue to learn from each other, to align their practices, and ultimately to support today's students in a rapidly changing world. In the last ten years, TWS has introduced a new 'digital education' curriculum, updated ICT infrastructure, and successfully regulated cell phone use using bottom-up change management to support the needs of students and teachers as they emerge. Parents and teachers believe that this developmentally oriented approach to education

will help students as they grow into healthy adults, equipping them with greater reserves of empathy, resiliency, and creativity for whatever endeavors they may pursue.

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Appendix A

Sample Interview Guide

Interview Guide

The following represents a sample interview guide for reflective notetaking with each participant. The major categories are included but prompts will vary depending on the participant's role in the activity system.

Code	
Role	
Warmer	
Notes	
Covid and online teaching	
Notes	
Tools/Technology	
Notes	
21st century competencies	
Notes	
Waldorf education as a developmental approach	
Notes	
Morality and resilience	
Notes	
Judging appropriateness	
Notes	

Prompts

Two different scripts were used to mirror the participant's role more closely. Given that the following represents a semi-structured interview, not all prompts were used in the interviews.

Parent Interview

Warmer

- What attracted you to Waldorf education? How did you come to be a part of the TWS community? What are some of the big changes that you've witnessed at the school over your time here?

Covid and online teaching

- What was it like having to shift online during the pandemic? Did you have a computer in the home prior to the pandemic? Was it difficult for your family to adjust to online learning? What were some of the challenges you faced? What was different about your experience of the Waldorf approach? What do you think your child thought about it? What elements of that approach would you like to see continue in in-person learning?

Tools/Technology

- What are some examples of Waldorf's approach to age-appropriate tool use that come to mind for you? Why do you think that the school does this?
- The teaching of reading is delayed when compared with public school timelines. What do you think about it? Why do you think the school does this?
- This delay in reading seems to parallel the delay in a student's access to the computer lab, projectors, and teaching them to use computer programs like Photoshop or Microsoft Word and all that kind of stuff. Is that fair to say? How do you feel about this delayed approach to using computers? What do you think it means for your child's ability to use them in the future?

- Many private schools advertise 1-1 iPad to child resources for their elementary school programs, what do you think about that? Was the delayed approach to technology use part of what attracted you to Waldorf education?
- Do you think it's important for schools to teach students how to use technologies like the computer during class time? Could you describe what you remember of your child's exposure to digital technologies at the school? When did certain new tools get introduced? Did you feel this happened at the right time? How did you child respond? What do you think are the effects of delayed use of technology for students? What do you see as the benefits of this delayed use? What about the disadvantages?
- What about at home? When did you introduce digital technologies? Could you describe your family's relationship with media use and digital devices? What benefits do they bring? What about challenges?

21st century skills

- What do you want your child to walk away from this educational experience with? What skills do you think are important for students to have to succeed in life? What about in the workplace? Are these different skills?
- There's a lot of discussion around digital literacies and critical thinking these days, which often feel like they are defined differently depending on who you talk to … how would you define them? Are there any particular skills that are really a priority for you for your child? How do you see your child developing these skills? What about skills like memory and creativity?

Waldorf education as a developmental approach

- I'm really simplifying what I know is a complex concept by saying this, but it is my understanding that underlying the Steiner approach is the idea that you must teach the 'right thing at the right time'. Could you tell me about how you understand this approach to education and the development of young people? What is the goal of this 'right thing at the right time' approach? Does it work? How do you evaluate that?
- Do you notice any differences in the development of your child's peers who go to different schools? What impact do you think that the Waldorf approach really has on physical, socio-emotional, cognitive, and linguistic development that is different from other schools? Could you share any stories of about your child that speak to this?

Morality and resilience

- Some of the reading I've done suggests that the controlling stimulus and overstimulation in the classroom is really important to Waldorf pedagogy, does that ring true for you?
- Waldorf education has an explicit moral orientation that sits at the foundation of curriculum and of teaching practice. Could you tell me a little bit about how you understand it? Is that moral orientation important to you as a parent? Whose responsibility is it to educate a child morally, a school's or a family's?
- How do you think children should be educated to participate effectively in a democracy? What about the technological challenges that face democracies with issues like fake news and algorithm-based information silos … what do you think should happen in schools to help children manage these issues in the future? What is being done at TWS?

- There's a lot of discussion around what short attention spans young people have now, what do you think about this? How do you support the development of your child's attentional capacities? How does the school approach this issue? Do you think there is a relationship between the use of cellphones and social media apps and attention issues?

Judging appropriateness

- I remember the Yondr program (a pilot program in which high school students retain possession of their cellphones during the school day but place their phone in magnetically sealed pouches so they cannot use them without permission from a teacher) had just been introduced when I was teaching here in 2018. What did you think about this program? Did it 'work'?
- If you were to try and define some parameters for 'appropriate' use of technology for students, both at school and at home, what might that look like? Is this a really difficult question? Why? What sources are you thinking about as authorities when you consider the question? What is your gut feeling? What are the benefits and risks of these tools?

Teacher Interview

Warmer

- What attracted you to Waldorf education? How did you come to be a part of the TWS community? What are some of the big changes that you've witnessed at the school over your time here?

Covid and online teaching

- What was it like having to shift online during the pandemic? What sources did you turn to to learn how to teach online? What elements of that approach might make it into your regular classroom?

Tools/Technology

- What kind of training do you get to use technology instructionally?
- What are some examples of Waldorf's approach to age-appropriate tool use that come to mind for you? Why do you think that the school does this?
- Another example that comes to mind for me is the delayed approach to reading. Why is the teaching of reading delayed?
- This delay in reading parallels the delay in a student's access to the computer lab, projectors, and teaching them to use computer programs like Photoshop or Microsoft Word and all that kind of stuff. Is that fair to say? How would you explain it to someone unfamiliar with the school?
- Do you think it's important for schools to teach students how to use technologies like the computer during class time?
- Many private schools advertise 1-1 iPad to child resources for their elementary school programs, what do you think about that? A big reason for the integration of different apps and technologies into the classroom is that it helps improve student engagement. How do you keep students engaged without the use of these tools?
- How has the school brought Waldorf into the 21st century? What input is there from the Ontario Ministry of Education to use computers with students and teach certain skills early on?

- Could you explain the current approach to technology for students at the school? How does it change as they move from Grade 1 to 12? What are some specific changes that take place between middle school and high school? When something like the computer is first brought into the classroom approach, are there any guidelines or goals for students? In what ways are tools used differently across grade levels?
- What do you think are the effects of delayed use of technology for students? What do you see as the benefits of this delayed use? What about the disadvantages?
- What do parents think about this delay? What do you say to them?

21st century skills

- What do you see as the most significant responsibility you have to students as an educator? What do you want them to walk away from this experience with?
- What skills do you think are important for students to have to succeed in life? What about in the workplace? Are these different skills?
- There's a lot of discussion around digital literacies and critical thinking these days, which often feel like they are defined differently depending on who you talk to … how would you define them? Where do you find moments to teach these skills? What about skills like memory and creativity? What skills and competencies do you and your colleagues discuss frequently? Which ones do you find are strong in students? Which ones do you wish were stronger?

Waldorf education as a developmental approach

- I'm really simplifying what I know is a complex concept by saying this, but it is my understanding that underlying the Steiner approach is the idea that you must teach the 'right thing at the right time'. Could you tell me about how you understand this

approach to education and the development of young people? What is the goal of this right thing at the right time approach?

- This is a really broad question: in what does your teaching practice focus on the physical, cognitive, and linguistic development of young learners? What about their socio-emotional development? How do you evaluate success in those areas? Could you share some stories of specific approaches that have really worked with students?

Morality and resilience

- Some of the reading I've done suggests that the controlling stimulus and overstimulation in the classroom is really important to Waldorf pedagogy, does that ring true for you?
- Waldorf education has an explicit moral orientation that sits at the foundation of curriculum and of teaching practice. Could you tell me a little bit about how you understand that? How does the educational journey at the school help students develop into "healthy and free moral actors"? What are some of the goalposts along that journey? Do you think there is a greater need now than ever to educate children towards this goal? Why?
- How do you think children should be educated to participate effectively in a democracy? What about the technological challenges that face democracies with issues like fake news and algorithm-based information silos … what do you think should happen in schools to help children manage these issues in the future? What is being done at TWS?
- There's a lot of discussion around what short attention spans young people have now, what do you think about this? How do you approach this issue of attention and its

deficits with your students? Do you think there is a relationship between the use of cellphones and social media apps and attention issues?

Judging appropriateness

- I remember the Yondr program (a pilot program in which high school students place their phone in magnetically sealed bags for the duration of the school day so they cannot use them without permission from a teacher) had just been introduced when I was teaching here in 2018. How did that program come to be at the school? What were the reasons for it? What was the perception of its use by the end of the year? How do you as a faculty make these decisions? What are some other changes around the use of technology that you've had to navigate together?
- I also remember being quite surprised to see a computer terminal in the library for students to search the catalogue, how did that come about?
- Is there engagement with Steiner's writing when you consider these programs? What about AWSNA publications? How do you decide what the right thing for the students is?
- If you were to try and define some parameters for 'appropriate' use of technology for students, what might that look like? Is this a really difficult question? Why? What different components make up this judgement of appropriateness? What sources are you thinking about as authorities when you consider the question? What are the benefits and risks of these tools?

Appendix B

Sample Observation Rubric

Observation Rubric

Date/Grade/Subject	
Lesson overview – stages, techniques, goals	
Interaction patterns – t-s, t-class, s-s, etc.	
Engagement – body language, participation	
Classroom – layout, physical setting	

Technology Present	**Observed use by instructor**	**Observed use by students**
Projector		
TV		
Computer		
Tablet		
Cellphone		
Reading		
Writing		
Other:		

New Media Literacies	**Observations**
Play	
Performance	
Simulation	
Appropriation	
Multitasking	
Distributed Cognition	
Collective Intelligence	
Judgment	
Transmedia Navigation	
Networking	
Negotiation	