Chapter 22
Teachers' Professional Learning Focused on Designs for Early Learners and Technology

Michele Jacobsen
University of Calgary, Canada

Sharon Friesen
University of Calgary, Canada

Barbara Brown
University of Calgary, Canada

ABSTRACT

In this chapter, the authors present and discuss findings from a two-year case study on teachers' professional learning. This investigation built upon existing research on early learning and technology to study teachers' professional learning in a community of practice, and the development of classroom-based learning designs and the ongoing inquiry of teachers from four school jurisdictions in the province of Alberta in Canada. Focus was on investigating ongoing continuous improvement of teacher design and assessment practices, to identify and share promising practices from the classroom, to capture teacher learning and engagement, to document the appropriate use of technology for learning and to identify and to understand system affordances and constraints for using technology with young learners.

INTRODUCTION

Young children are growing up in environments rich in mobile and gaming technologies and, as such, they enter school with diverse technological experiences. Educational research is needed to understand early childhood experiences with technology and how to leverage young children's home and recreational technology use for meaningful learning in school. Research on professional learning for teachers that enables them to design appropriate learning experiences that use contemporary technologies at school is needed. Past research about youth media habits often warned about the perils for young learners using

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technologies (Cordes & Miller, 2000; O'Reilly & O'Neill, 2008; Schmidt, Rich, Rifas-Shiman, Oken & Taveras, 2009) and shared fears about technology being misused (Conners-Burrow, McKelvey, & Fussell, 2011). Research has pondered the appropriate age for children to start using computers (Karuppiah, 2014). Early critiques tended to be based on one-way communication technologies, such as television use (Swinburn & Shelly, 2008; Wilson, 2008) and using computer-assisted instruction (Elkind, 1996; Haugland & Wright, 1997). More recent critiques focus on possible online dangers (O'Reilly & O'Neill, 2008) or issues with overall screen time (Ernest, Causey, Newton, Sharkins, Summerlin & Albaiz, 2014). In contrast, other researchers argue there are developmentally appropriate and beneficial ways for practitioners to employ technologies with early learners (Bers & Kazakoff, 2013; Clements & Sarama, 2003).

BACKGROUND

Contemporary research on the healthy development of young children in a digital age should guide teachers' appropriate use of technology in pre-school and primary classrooms (Barron, Bofferding, Cayton-Hodges, Copple, Darling-Hammond & Levine, 2011). Neumann and Neumann (2014) argue that early literacy skills can be enhanced using newer technologies such as touch screen tablets (i.e. iPads, mobile devices) and appropriate applications, and with scaffolding by "providing prompts and hints that help learners figure it out on their own" (Sawyer, 2006, p.11). Similarly, other researchers maintain that using technology with early learners can expand learning opportunities for all students (Bers, 2008; Bers & Kazakoff, 2013; Plowman & McPake, 2013) including students with complex needs (Kucirkova, Messer, Critten & Harwood, 2014).

Effective use of technology with young children focuses on the thoughtful and strategic enhancement of social relations with peers and adults, fosters exploration and the manipulation of objects and the social construction of knowledge, the creation of representations, involves listening to and reading books, and children's engagement in play (Barron, et al., 2011; Blackwell, Lauricella & Wartella, 2016; Neumann & Neumann, 2014). The learning potential of technology can best be realized when digital technologies are used by teachers for students' powerful learning through creative design and expression, playful exploration, experimentation, design and invention versus information delivery (Singer, Golinkoff & Hirsh-Pasek, 2009). For example, Mitchell Resnick's work focuses on using technologies to design, create and invent (Papert, 1980; Resnick, 2002). Resnick's work on ScratchJr for young children, a modified version of the graphical programming language Scratch, focuses on providing appropriately designed and powerful digital creation and computer programming tools that align with early learner's unique developmental and learning needs (Flannery, Kazakoff, Bonta, Silverman, Bers & Resnick, 2013).

Assisting and supporting teachers' professional learning requires more than helping them to learn how to use technology. Teachers want and need professional learning that assists them in developing responsive instructional design practices and in learning about appropriate technologies for learning in and for the contexts in which they teach (Daniels, Friesen, Jacobsen, & Varnhagen, 2012; Voogt & McKenney, 2017). Teacher's professional learning within our study was supported through a community of practice (Lave, 2009; Lave & Wenger, 1991; Wenger, 2009). Communities of practice are guided by a social theory of learning that understands learning as a social phenomenon. Social participation is a primary focus of the community as the group of people come together through a shared concern for something they do and then they learn how to do it better as they interact with each other (Wenger & Wenger-Trayner, 2015). In the present study, the research community of practice provided participants

with an opportunity to build "collective learning in a shared domain of human endeavour" (Wenger & Wenger-Traynor, 2015, para. 4). All of the teachers and school leaders involved in this case study were engaged in professional learning experiences that focused on the design of rich, inquiry based work for young learners in kindergarten (age 5) to grade four (age 9 – 10 years), and on the development of pedagogical strategies to promote intellectual engagement (Galileo Educational Network Association, 2013; Jacobsen, Lock & Friesen, 2013; Friesen, 2009a, 2009b). As a condition of the school jurisdiction's involvement in the research community of practice, all of the teachers and kindergarten to grade four students in this study had access to mobile, handheld technologies and to a reliable and wireless technological infrastructure.

MAIN FOCUS OF THE CHAPTER

The present case study research builds upon research on designs for learning with technology, communities of practice for teacher learning, as well as the work of teachers who employ contemporary digital technology and networks in ways that are developmentally appropriate and beneficial for young learners. Current research that builds on the existing knowledge base and the learning designs by classroom teachers to sponsor inquiry and intellectual engagement can help the teaching profession to deeply understand the interactive uses of technology by young children in contemporary classrooms and participatory cultures (Hattie & Anderman, 2012; Jenkins, Clinton, Purushotma, Robinson & Weigel, 2006). In this chapter, the authors examine research communities of practice approaches to teacher professional learning and the impacts of this approach on teaching and learning, as well as the ways that schools can best support engaged teaching and engaged learning with technology in Kindergarten to Grade 4. What we accomplished in this case study research was to identify and share promising practices for teacher professional learning, and to capture evidence of student and teacher learning and intellectual engagement.

Theoretical Framework

Willms, Friesen and Milton (2009) and Jacobsen and Friesen (2011) describe intellectual engagement as the interplay between cognition and emotion; the interplay between worthwhile and challenging work and a personally absorbing focus that is creatively energizing. Learning science researchers, such as Bransford, Brown, and Cocking (2000), Sawyer (2006, 2007), Barab, Arici, and Jackson (2005), Gresalfi, Barab and Sommerfeld (2012), and Zhang, Scardamalia, Reeve and Messina (2009), have identified the kinds of learning environments that promote intelligent action as a shared accomplishment, and learning as being knowledge centered, learner centered, assessment centered and community centered. Knowledge centered emphasizes teaching for deep understanding, competency and mastery in a discipline versus memorization or superficial coverage. Learner centered means paying close attention to the knowledge, skills and attitudes that learners bring to the classroom to inform what teachers need to do to help learners grow and take their next steps toward mastery. Assessment centered learning environments are designed to make student learning visible to both teachers and the students themselves (Hattie, 2009), and assessment data is used to inform instructional designs and practices. Knowledge, learning and assessment all takes place in a collaborative learning community where teachers and students accept increasing responsibility for their own learning and also for the learning of everyone else within the community of practice. Scardamalia and Bereiter (2006) describe knowledge building as an intentional

focus on idea improvement and building knowledge in community, which align with this case study's focus on knowledge, learning, assessment and community. Bereiter and Scardamalia (2010) argue that young children can genuinely create new knowledge and engage in theory building, as opposed to merely carrying out activities that resemble work by mature scientists and innovators.

Case Study Methodology and Context

A mixed method case study approach, using both qualitative and quantitative methods for data collection and analysis (Creswell, 2014), was enacted in this research. Case study research intentionally focuses on the complexity of a single case, or a bounded system, as the phenomenon of interest for disciplined investigation (Merriam, 1998; Stake, 2005). A case study approach is appropriate to develop both a holistic and deep understanding of real-world contexts in order to produce and share findings relevant to similar real-world contexts (Yin, 2009), such as how young learners and their teachers engage in learning with technology. A case study research design offers distinct advantages in situations where the research team seeks to better understand by asking "how" or "why" about certain contexts within which the researcher has little or no control (Yin, 2009). One reason for conducting a case study of a bounded system is to generate sharable findings that can be informative of the experiences of the average group (Yin, 2009). For this case study (Merriam, 1998; Stake, 2005) the bounded system was the early learning and technology research community of practice whose shared purpose and goal was to explore the effective use of emerging technologies to support learning for kindergarten to grade four learners. Two primary research questions bound the research reported on in this chapter: 1) What were the innovative approaches to teacher professional learning that were implemented, and what was the impact on teaching and learning? 2) In what ways can schools best support engaged teaching and engaged learning with technology in Kindergarten to Grade 4?

Case Study Context

The context for this research is the Early Learning and Technology Research Community of Practice (ELT-RCOP), which included four school jurisdictions in the province of Alberta, in Canada, a research team from the Werklund School of Education, University of Calgary, mentor teachers from the Galileo Educational Network, a professional learning and leadership organization in the Werklund School of Education, and the provincial ministry for education, Alberta Education. The ELT-RCOP was developed in response to a call from the provincial ministry, Alberta Education, for universities and school jurisdictions to form a ELT-RCOP to intentionally explore and document effective uses of technology to support learning in kindergarten to grade four classrooms. Partners in the ELT-RCOP each committed to the shared goal of designing and enacting digitally rich, knowledge building, and inclusive learning environments for learners and teachers in the early grades (K-4). The bounded system for this case study is the ELT-RCOP. Key initiatives proposed by the four jurisdictions included: i) using mobile technology to support language acquisition and development of early literacy, ii) enhancing learning through mobile and kinesthetic technology, iii) using iPads in the classroom as an assistive technology for diverse learners, iv) preparing K-4 learners for the 21st century through inquiry learning and universal access, and v) supporting differentiated instruction and student engagement through use of digital media, Web 2.0 tools and digital cameras. The Early Learning and Technology (ELT) initiative is a part of an ongoing provincial research initiative into best practices in classroom technology integration. In

this multiple partner, multiple school jurisdiction research initiative, mentor teachers from the Galileo Network supported classroom teachers in designing technology-rich learning environments and tasks. Via regular school visits, mentor teachers guided classroom teachers through an inquiry and discipline oriented instructional design process that focused on developing authentic and academically rigorous work, assessments for learning, elaborated forms of communication, connections beyond the school and the appropriate use of technology.

Professional Learning Activities for Teachers

During the first year of the ELT-RCOP, Galileo Network mentors provided three full days of on-site professional learning for teacher participants in the four school districts involved in the study. During the second year of the study, participants requested a blend of professional learning days and flexible, on demand support. Accordingly, the Galileo Network mentors also offered additional online/offsite support to all teacher participants as required using a blended program of on-site professional learning sessions, school and jurisdiction visits, as well as mentoring support and collaboration through video/audio conferences, and email. The extent of access to rich professional learning and support with design from the mentors varied from teacher-to-teacher, and was dependent on individual needs. The professional learning strategies that supported teacher learning are described further in the results section (see Tables 4 and 5). The Galileo Network mentor teachers consistently focused professional conversations and mentorship on teaching for deep learning and understanding, designs for inquiry and the design of learning environments that sponsor intellectual engagement.

Professional learning sessions employed elements of the Canadian Education Association Teaching Effectiveness Framework (Friesen, 2009b) and the Discipline Based Inquiry Rubric (Galileo Educational Network Association, 2013): authenticity and academic rigor, learning in the world, fostering deep understanding, appropriate and creative use of technology, active exploration and connecting with experts, assessment for learning. Both of these resources provided strong support for the design and review of learning tasks that foster engaged teaching and learning with the effective implementation of technology. Participants used the elements summarized in Table 1 to guide the design of their learning tasks and professional conversations about teaching and learning.

One approach to mobilizing the outcomes of the research and also to support and inform classroom teacher's technology integration designs and implementation in K-4 classrooms and learning settings was through the creation of the Early Learning, Early Grades area of the Galileo Network website (http://galileo.org/earlylearning/). Composite videos from interviews with teachers and researchers about early learning with technology extend the value and depth of the website. A Technology tab offers links to articles, websites and resources for both teachers and parents (http://galileo.org/earlylearning/technology/). Study participants were encouraged to make their learning and their students' learning visible by collecting and sharing their planning materials and outcomes, as well as student work.

Overall, the ELT-RCOP meetings, on-site visits and online communications supported by the Galileo Network mentor teachers as well as the comprehensive resources accessible on the Early Learning, Early Grades web site, guided classroom teachers through an inquiry and discipline oriented instructional design process that focused on developing authentic and academically rigorous work, learning in the world, fostering deep understanding, making connections beyond the school and with experts, designing assessment for learning and appropriately using technology and elaborated forms of communication.

Table 1. Elements of designing worthwhile learning tasks with the effective implementation of technology

Summary of Elements of Worthwhile Work with Technology	
Authenticity and Academic Rigor	• Real problems, issues, questions or ideas that are significant to the discipline(s) and community and are meaningful for the students. • Students engage in ways of knowing that are central to the disciplines developing and applying strong habits of mind.
Learning in the World	Mirrors the kinds and ways of working an expert in the discipline or field would perform.
Foster Deep Understanding	• Requires significant intellectual investment (contemplation, interpretation, meaning-making, critique) & innovative thinking. • Demonstrates understanding of important concepts. • Involved deeply in the work and know why it matters.
Appropriate and Creative Use of Technology and forms of Communication	• Technology is used in a purposeful manner that demonstrates an appreciation of new ways of thinking and doing. The technology is essential in accomplishing the task. • Students have agency in determining which technologies are most appropriate to the task. • Students conduct research, share information, make decisions, solve problems, create meaning and communicate with various audiences inside and outside the classroom. • Students make sophisticated use of multimedia/hypermedia software, video, videoconferencing/ webconferencing, simulation, dynamic geometry, databases and/or programming. • Students, parents and the larger community have ongoing, online access to the study as it develops.
Active exploration and Connecting with Experts	The work students undertake requires them to engage in productive collaboration with discipline and other experts.
Assessment for Learning	• Assessment is focused on improving, guiding and deepening student learning. • A variety of formative assessment data is gathered to make instructional decisions and improve practice. • Assessment criteria are collaboratively designed with students to reflect authentic real world standards for high quality work.

Research Community of Practice (ELT-RCOP) Meetings

The two-year professional learning program included five research community of practice meetings designed by the research team (April, 2012, October, 2012, May 2013, October, 2013 and May 2014). The ELT-RCOP meetings were designed to specifically support the following research-informed goals of the initiative:

- Use of purposeful and meaningful technology for deep learning, for communications and to demonstrate and amplify student understanding (Barron et al., 2011; Exley, 2008);
- Impact learning with technology (i.e. related to student engagement, student agency, and student competencies) (Darling-Hammond et al., 2008);
- Use formative assessment for learning strategies (Wiske, Franz, & Breit, 2005);
- Make student learning visible (Darling-Hammond et al., 2008; Hattie, 2009); and
- Shift in professional practice, in particular towards a more student-centered practice (Fullan & Donnelly, 2013; Wiliam, 2011).

Teachers' design work was set in the broader contexts of the Alberta Education Ministerial Order on Student Learning (Alberta Education, 2013b), the ministry's attendant shift to competency based curricula, and the Learning and Technology Policy Framework (Alberta Education, 2013a), and in the context of contemporary research on learning with technology. Almost all of the original group of

year one teachers (n=45) returned as participants in year two, and collaborated together with a clearly informed purpose to employ the ELT-RCOP research foundations and Galileo Network inquiry design materials to design new learning tasks.

Case Study Data Sources and Evidence

In this study, multiple sources and types of evidence were collected over a two-year period to make knowledge claims in response to the key research questions (Yin, 2009). The following methods were employed to document the impact and outcomes of the early learning and technology initiative and to provide triangulation and convergence during the data analysis: individual interviews (n=4); focus groups with teachers, and school or district leaders (i.e. project leads, consultants) (n=8); online needs assessment survey with educators (year one; n=20) and follow-up survey (year two; n=51); jurisdiction site visits including onsite work with teachers and classroom observations using an established protocol (n=16); qualitative documentation (i.e. learning designs) provided by participants (n=32); and field notes and artifacts (i.e. examples of student work) gathered during the ELT-RCOP meetings (n=5).

Evidence of inquiry from teacher and learner exemplars and other documentation was collected via a shared online drive where teachers placed teaching and learning materials. Over the two-year period, 32 teachers shared rich materials from their work with K-4 learners. Researcher field notes, along with teacher designed projects and assessments, and examples of student work, are included in the analysis. Interviews were guided by a prepared set of questions, as well as providing open-ended opportunities for interviewees to expand upon themes and ideas. Some participants (n=4) preferred responding to questions in individual interviews and others (n=8) preferred to provide responses in focus groups. An online needs assessment survey captured data from teachers about their technology experience and use, and teacher knowledge and practices with inquiry-based learning. Classroom observations were conducted in sixteen classrooms using an established observation protocol (Jacobsen, Saar & Friesen, 2010; Daniels, Friesen, Jacobsen & Varnhagen, 2012) Researchers conducted disciplined observations in classrooms during lessons that were chosen / identified by the teachers.

The research team also designed and participated in ELT-RCOP meetings in years one and two to share ongoing research progress and to support teachers in sharing promising practices. One intent of the ELT-RCOP meetings was to share ongoing progress with research activities and to provide teachers with support in networking and sharing promising practices. For example, early findings from conference proceedings were shared with the participants (Jacobsen & Friesen, 2014) during one of the ELT-RCOP meetings. Furthermore, data from collective knowledge building and participant responses to practice at each ELT-RCOP meeting was collected for analysis.

Meeting 1: Pre-project RCOP (April) - group contributions to design, field notes on inquiry (45 participants)

Meeting 2: Year I RCOP (October) - group discussion of inquiry projects, group reflection and knowledge building (45 participants)

Meeting 3: Year I RCOP (May) - share and assess examples of classroom work, extensive field notes from each group, collective learning outcomes (45 participants)

Meeting 4: Year II RCOP (October) - share and assess examples of classroom work, field notes

Meeting 5: Year II RCOP (May) - sharing celebration, field notes from each group (45 participants)

Overall, multiple quantitative and qualitative data were collected over a two-year period and informed the findings of this study.

ANALYSIS AND RESULTS

In the sections that follow, we present research results in two areas: 1) Impact of innovative approaches to teacher professional learning on practice and teacher's professional growth; and 2) Supporting engaged teaching and engaged learning with technology in Kindergarten to Grade 4.

Evidence of Impact of Professional Learning Activities

In order to support engaged teaching and learning with the effective implementation of technology, the professional learning activities and sessions over the two years employed the elements summarized in Table 1 to guide the design of their learning tasks. The elements of worthwhile work and appropriate use of technology (i.e. developing authentic and academically rigorous work, learning in the world, fostering deep understanding, making connections beyond the school and with experts, designing assessment for learning and using technology and elaborated forms of communication) were used to review the learning tasks completed over the year and submitted online. Evidence was gathered from observations during professional learning sessions, presentations at ELT-RCOP meetings, and an in-depth assessment of the learning tasks posted to a common online drive. As detailed in Table 2, a majority of the tasks we reviewed contained elements of both worthwhile work and appropriate uses of technology.

While the review of learning tasks (Table 2) indicates reasonable levels of facility regarding the creation of worthwhile tasks and appropriate uses of technology, professional learning sessions and on site work continued to employ the Canadian Education Association Teaching Effectiveness Framework (Friesen, 2009b) and the Discipline Based Inquiry resources (Galileo Educational Network Association, 2013) to focus upon these areas within the community of practice. For example, a grade four teacher involved in the project designed an inquiry-based project, entitled "Happiness Fair" (Box 1), drawing on some of the elements of worthwhile work and appropriate uses of technology.

Table 2. Assessment of worthwhile work and appropriate uses of technology in learning tasks shared by participants

Extent of …	Worthwhile Work in the Tasks Reviewed	Appropriate Uses of Technology in the Tasks Reviewed
Strongly evident in the task and supported by observation, discussion and/or artifacts	16%	8%
Often evident in the task and supported by observation, discussion and/or artifacts	16%	24%
Somewhat evident in the task and supported by observation, discussion and/or artifacts	38%	46%
Little evidence in the task or from observation, discussion and/or artifacts	38%	16%
Not evident in the task, or from observation, conversation or artifacts	0%	8%

Box 1. Happiness Fair

Grade four students engaged in a "Happiness Fair" to coincide with a Children's Mental Health Awareness Day. Parents were invited to the fair and topics presented were all issues that affect overall well-being of kids. Various text and multimedia projects were created as part of the fair. Students created public service announcements to 'hook' people and draw them in to look at their complete presentations. They introduced the issue (i.e. bullying, grief, etc.), provided statistics and important information about the topic. A tri-fold presentation piece was created and included information on (1) how does happiness affect other areas of your life? (2) How does your chosen issue affect people's happiness? (3) What can you do to make yourself a happier person? (4) How can you influence the happiness of others? Students also created a take-away piece, such as a bookmark, pamphlet or handout. Throughout the inquiry, students considered essential questions, such as: What are the biggest issues affecting kids happiness today? How can I make sure I am as happy as possible? (What are the tools and strategies needed to deal with thoughts, emotions and actions? How do I deal with how I feel?) How can I influence the happiness of others?

At the end of the inquiry, students also reflected on their thinking and learning and were guided by further questions:

- What was the topic that your group did for the Finding Happiness Project?
- What is something you did during this project that you think you will remember for the rest of your life?
- What was the most challenging part of this project for you?
- How did utilizing technology make this project better?
- If you could turn back time and do this project again, what would you do differently?

Another teacher used the following phrases when reflecting on how students used technology during a story writing process:

- Active, hands-on, engaging and empowering learning…student-led
- Developing student agency and giving children control-students' own ideas, feedback, working in groups to help each other, choice of topic, choice of final product
- Providing adaptive scaffolds to help children progress step-by-step
- Support children's learning-observations of digital stories created by others, students recording their own progress, providing peer feedback
- Assistive technologies improve ability to learn, move, communicate and create – students who are reluctant writers can easily create their story digitally without having to "write" it, can feel comfortable and confident with the technology
- Enhancing communication (class blogs, digital portfolios, audio recording reading)
- Documenting learning (digital photo of work progressing, video speech)
- Enabling the development of professional quality work (publish digital books, brochures, podcasts, movie story)

Examples of learning designs were continually gathered by project participants and researchers and used to clarify interpretations of the elements of worthwhile work and appropriate uses of technology within the community of practice. Technology enabled tasks often made student learning more visible – both process and product – and promoted formative assessment that successfully reached different students at multiple levels of experience and readiness.

Evidence of Student's Intellectual Engagement and Deep Learning

Using an established classroom observation protocol (Jacobsen, Saar & Friesen, 2010) researchers carried out classroom observations to observe teachers and learners in the early grades. The time frame for observing lessons was divided into three sections: first, second and final third of the classroom time. The levels of student engagement are characterized on a level of engagement scale: Level 1= disengaged -

includes inattention, attending to an alternative activity, off-topic conversation, or misbehaviour; Level 2 - ritualistic compliance - identified as working on assigned activities without enthusiasm or personal investment; Level 3= academic engagement - identified by on-task behaviours that signal a serious engagement in class work; these include attentiveness, doing the assigned work, and showing enthusiasm for this work by taking initiative to raise questions, contribute to group activities and help peers; Level 4 = intellectual engagement - refers to absorbing, creatively energizing focus requiring contemplation, interpretation, understanding, meaning-making and critique which results in deep, personal commitment to explore and investigate an idea, issue, problem or question for a sustained period of time.

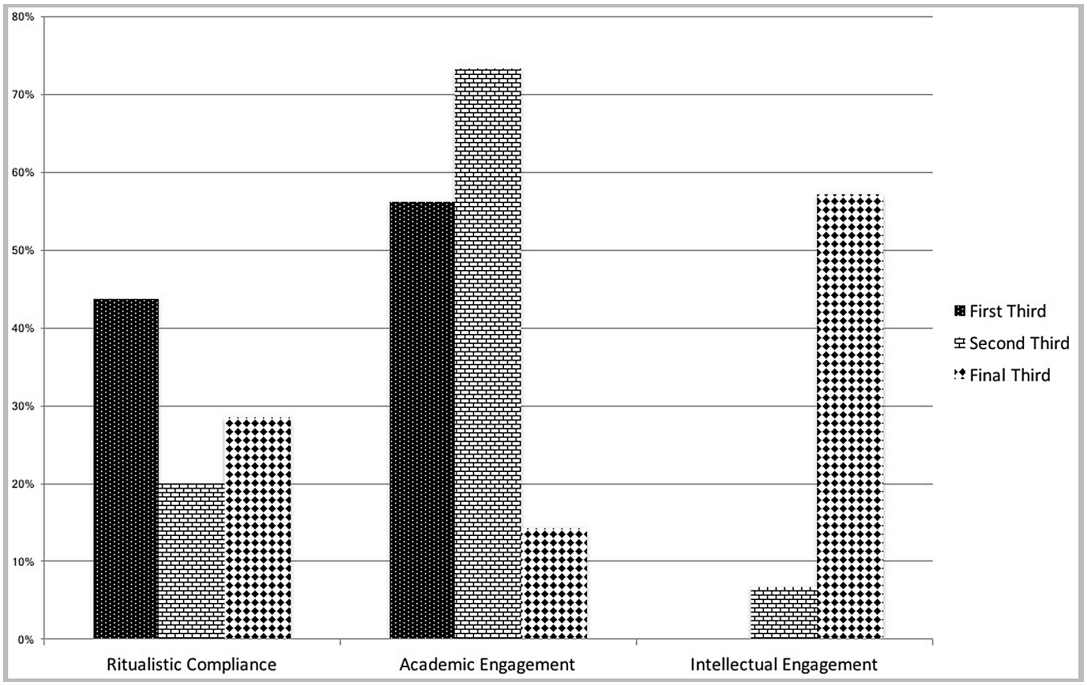
During the classroom observations, intellectual engagement (level 4) was observed in eight of the sixteen classrooms by the middle and end of the lesson. In three of the sixteen classrooms, ritualistic compliance was consistently observed across all three parts of the lesson. When high levels of intellectual engagement were observed, it was common to see students working in pairs or groups using a range and diversity of technological resources and processes in appropriate and real-world ways. A relationship was observed between high levels of intellectual engagement and learning tasks designed to develop 21st century skills such as critical thinking, self-direction, teamwork, collaboration and project planning. Teachers were fully present and responsive to student needs in classrooms where intellectual engagement was observed; teachers circulated in the room and worked closely with students as learning emerged, and worked with groups and individual students on tasks and activities that had personal value and value beyond the school.

In contrast, classrooms where ritualistic compliance was observed during the whole lesson or during a portion of the lesson, included many of the following elements: students displayed little enthusiasm or personal investment in the learning tasks; students were given little or no opportunity for self-direction and creative thinking; students used technology in a prescribed and lock-step manner; and students worked individually on a step-by-step task controlled by the teacher. Ritualistic compliance was observed in classrooms where students spent the majority of time listening to the teacher lecture or watch the teacher use an interactive whiteboard or give a demonstration. In classrooms where ritualistic compliance was observed, the students listened to instructions or appeared to listen to instructions and were then asked to echo back exactly what the teacher asked them to do. Too often, students were only allowed to use the technology after extended periods of time listening to the teacher. Once students started to explore and play with ideas using technology, the researchers started to see a gradual shift from ritualistic compliance to academic engagement. Often, student explorations were disrupted and excitement levels quickly faded when the teacher gathered the whole group to view another demonstration or listen to more whole class instruction. Technological issues also disrupted explorations. One researcher observed a grade two class in a computer lab, and noted, "*There were so many problems with technology that it interfered with student learning. The teacher became completely discouraged and exhausted*." As a result of technology issues, student engagement declined through the lesson to a low point of disengagement.

Despite the challenges some teachers and students experienced in using technology in the classroom or in lab settings, levels of intellectual engagement were observed with students in half of the classrooms over the duration of the study. Figure 1 shows the levels of engagement observed during the first, second and final third of the class time using the classroom observation data from the project.

In one classroom where intellectual engagement was observed during two thirds of class time, the level and type of engagement extended to 100% of the students and was described by the researcher as follows:

Figure 1. Calculated percentages during first, second and final third of observed lesson for ritualistic compliance, academic engagement and intellectual engagement



Grade one students worked alone, in pairs and in collaborative groupings and used a variety of software programs while reviewing and editing stories. The students were observed creating pictures, selecting sounds and recording voice; they were working at their own pace. It was evident the intellectual investment was high and students were absorbed in work and thought processes. Moreover, the instructional style was consistently responsive to the emerging needs of students throughout the lesson. Some students required direct instructions and others required feedback or scaffolding to prompt next steps. [Researcher Field Notes]

Overall, researchers observed a range and diversity of task designs, pedagogy and technology during the sixteen classroom observations. During the first, second and final third of the class time ritualistic compliance and academic engagement were observed; intellectual engagement was observed in the second and final third in some classes.

Teacher Perspectives on Professional Learning

The study aimed to document the innovative approaches to teacher professional learning and the impact on teaching and learning. First, the opportunities provided for collaboration and the quality of professional learning were cited by participants as powerful drivers of teacher and leader learning. Several teachers reported that professional learning from the Galileo Network mentors and involvement in the ELT-RCOP led to changes in their pedagogical practices, such as ensuring the students had pervasive access to the technology (i.e., the "tools of their culture" as described by one teacher), increased time

talking to colleagues about designing classroom tasks and assessment rubrics, and increased connections with teachers from other school jurisdictions to analyze effective task and assessment designs.

Several teachers described the characteristics of authentic and academically rigorous learning tasks that sponsored engaged learning: personalization of the task, emotional tie to the task, establishing shared expectations for the work with students, opportunities for reflection and metacognition, students experience both frustration and success in their learning, students develop strategies for working through frustrations, problem solving, hard work but a good kind of hard work that makes students think, bringing in the community, connection with student lives outside of school, reaching students of different abilities, and students respect the work so they become advocates for the work. Teachers also described the appropriate role for technology in young students' learning: Start with the discipline in mind and then technology is a part of that discipline, use technology to make learning visible – process and product, democratizing of knowledge, everyone has a voice – everyone has a say – played a major role, technology removes barriers for the "non-learners", students more willing to revisit and revise their digital works, students able to take risks (easier to revise easier to revisit), makes learning mobile (home and in and outside the classroom), helps the learning become more real (connecting with experts), students became their own community (helping each other through their issues – collaboration), students giving each other feedback on their work, supports the social construction of knowledge, helps to continue the conversation (self- teachers-parents), and using technology is an authentic tool for expressing themselves and their learning.

The year two survey included questions asking teachers about their confidence in designing rich classroom tasks. A multidimensional visualization (Francis, Jacobsen & Friesen, 2014) is used to present the findings for the teachers' levels of confidence in designing tasks according the elements of worthwhile work and appropriate use of technology from the Canadian Education Association Teaching Effectiveness Framework (Friesen, 2009b) and the Discipline Based Inquiry Rubric (Galileo Educational Network Association, 2013). Figure 2 shows teachers' perceptions in designing tasks with characteristics of inquiry according to five categories each depicted as a unique section in the graph: authenticity and academic rigor, learning in the world, appropriate and creative use of technology, active exploration and connecting with experts, and assessment.

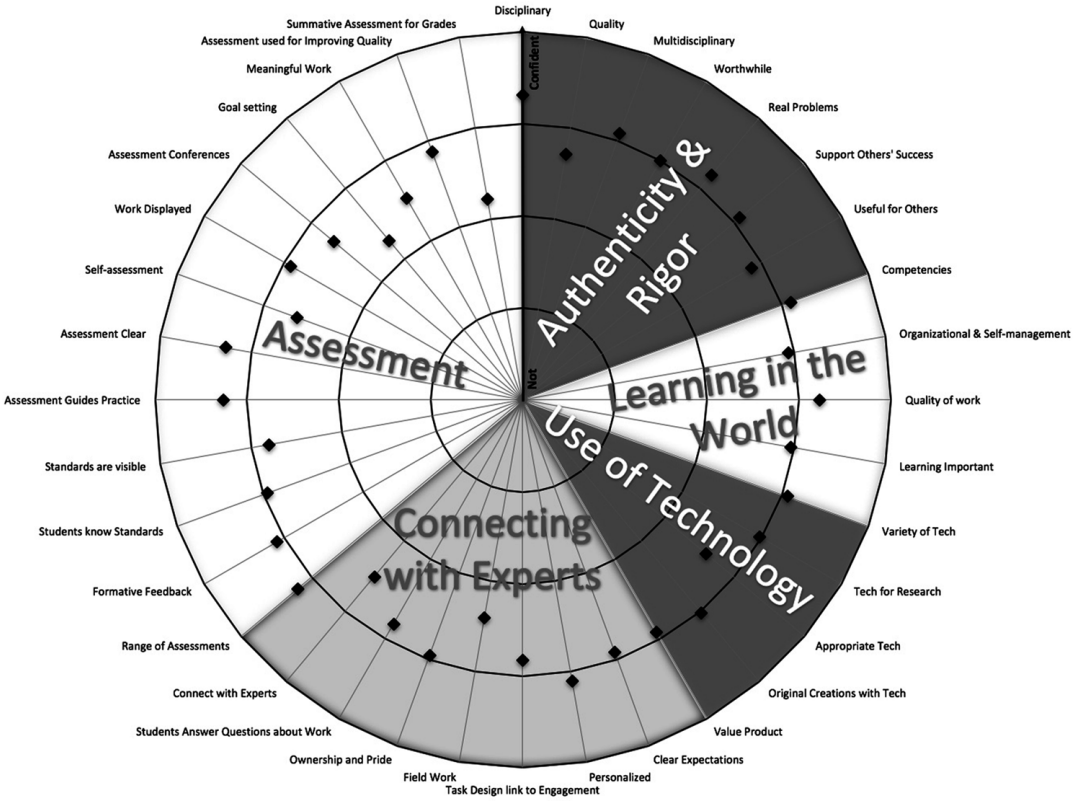
The following scale was used as indicators for levels of confidence moving from the outer edge of the graph as the highest level to the center of the graph as the lowest level: I am confident this is so and have data to support my view = 1; I am confident this is so, but have few data to support my view = 2; I am not sure about this matter = 3; I am pretty certain this is not the case, but have few data to support my view = 4; I am confident this is not the case, and have data to support my view = 5.

The points closer to the outer edge of the graph are areas the teachers selected with higher level of confidence and the points closer to the center of the graph are areas of least confidence. During the second year of the initiative, teachers expressed increased clarity and confidence in their task design and integration of technology as compared to year one. The following sample comments illustrate participant investment in this work:

I have learned better the characteristics of engaging tasks. I feel I will consider my projects using this rubric in the future. [Participant A]

The inquiry rubric is a great tool to evaluate what you're doing in the classroom. [Participant B]

Figure 2. Teachers' perceptions in designing tasks with elements of worthwhile work and appropriate use of technology



Enable students to use a range of technologies to demonstrate new ways of thinking (a real focus that is starting for me). [Participant C]

Based on these findings, additional design work and professional learning needs to continue to focus on developing and supporting student tasks and technology-rich work that is absorbing, creatively energizing, and requires thought processes such as analysis, synthesis, conjecture, reasoned judgement, creation and innovation. Professional learning needs to focus on increasing teacher confidence in collecting evidence of exemplar tasks guided by the elements of worthwhile work and appropriate use of technology.

Supporting Engaged Teaching and Early Learning With Technology

Teachers are able to identify the opportunities and affordances in using technologies for teaching and learning despite the inherent challenges in scaffolding technological learning experiences for young learners. In reviewing the interview transcripts, survey responses and dialogue with participants, it was evident there is value in using technology with young learners and making pedagogical decisions in instructional design about meaningful and purposeful use of technology with young learners. Teachers were asked, "What supports do you need to foster this work in your context? The sample comments

shown in Table 3 suggest affordances that need to be in place to support technology use including: opportunities to develop connections with other professionals and researchers in the field, opportunities for ongoing feedback and mentorship in a fail-safe professional learning environment, and support for investing time for learning and sharing in a community of practice.

Data shows a strong investment by teachers in developing rich tasks using technology with young learners. In the online drive, teachers (n=32) shared task designs and evidence of student learning, assessments and reflections demonstrating a commitment to the initiative. Participants provided data through surveys, interviews and presentations at the bi-annual research community of practice meetings. For example, in the survey, participants identified barriers or challenges associated with engaged teaching and learning with technology. The following sample of comments from teacher surveys demonstrates there is an area for growth in supporting practitioners in how to use technologies at the beginning stages of designing inquiry rich tasks:

Creating authentic tasks that are inquiry based. How to design good questions. Where do you begin? [Participant D]

Where can one find exemplars of 'true' inquiry processes? [Participant E]

What are some projects that other schools have tried? [Participant F]

Findings indicated that access to technology and leadership support can be inconsistent in schools with early grades. While the majority of the teachers in the project had access to technology (access to a wireless infrastructure and mobile technology was a condition in being part of this initiative) and most school leaders were supportive of using technology appropriately with young learners, one teacher in one school described limited access to technology in the classroom as a barrier. Despite the school's participation in the ELT initiative, making provisions for teachers to access technology in early grade classrooms was not a priority. The teacher shared past experiences with effective technology use with learners at another school where there was access to technology in the classroom and the leadership team was supportive of using technology in early grades. However, in this case, this teacher was very discour-

Table 3. Teacher identified supports for engaged teaching

Comment Category	Sample Participant Comment(s)
Participants need opportunities to network and build connections with others	• Release teachers/professionals to meet together • Conversations with other teachers to keep in touch. • How do we filter this out to the rest of our school communities?
Participants need feedback/ mentorship/ fail-safe professional learning	• Need constructive Feedback and guidance along the way • Need help with task/ question creation. • Increase (school based) budgets to support inquiry learning with technology tools, field trips etc. • [Need] freedom and flexibility to try new things. Learning from mistakes.
Participants need support to invest time for learning and sharing	• Need time to think and organize it! • Need time to learn. • Need time to read. • More focused sharing on [technology] use in classrooms. Less large scope and a few more focused classroom examples or lessons.

aged with attempts to use technology and it was evident that providing early learners with technology-rich learning experiences was not a leadership priority in this school.

A key element for success in this initiative were collaboration and quality professional learning experiences in a community of practice. These key elements were also identified as ways to help mitigate many of the barriers and challenges in using technology. In other words, teachers relied on collaboration with others to gather ideas, seek input or help resolve issues in planning for using technology with students. Professional learning experiences provided teachers ranging in different levels of technology adoption from those new to using technology with young learners to those with more expertise and able to help mentor others, with tailored experiences to increase confidence and use in integrating technology in task design.

Teachers were asked to describe the professional learning opportunities they participated in as part of their involvement in the ELT-RCOP. Table 4 provides comment categories and comments from the year two survey responses identifying the professional learning strategies teachers found supportive during their involvement in this initiative.

When participants were asked to describe professional learning opportunities that have been most helpful as part of the ELT initiative, the responses were related to networking and building connections in the ELT-RCOP, collaboration, developing flexible partnerships with mentors and researchers, creating/sharing with others and ongoing learning and improvement. Table 5 provides sample comments from participants about various professional learning opportunities in this initiative.

Comments about professional learning opportunities afforded due to participation in the ELT initiative suggest participants valued building relationships and engaging in collaborative knowledge building during the community of practice meetings and strengths of this model included communicating and sharing ideas with others, discussing ideas, learning about what others are thinking/doing, collaborating with others, relationship building and reflecting on practice. Secondly, the participants valued using research-informed frameworks as part of the ELT-RCOP meetings and coaching provided during planning

Table 4. Professional learning strategies identified by teachers

Comment Category	Number of Comments	Exemplary Comment(s)
ELT-RCOP	34	• Bi-annual community of practice meeting with all people involved in the project. These have been very useful as we have been able to share our ideas and experiences with others. • Inspired after our meetings.
Planning Days	11	They helped with selecting projects and technology and providing feedback and an opportunity for reflection on the work that has been done. It has also been beneficial to have other people providing ideas for future growth.
District Support	10	• Grade One Science Community of Practice [District] • Having the IT consultant in my classroom. • District wide professional learning on a variety of technology initiatives/uses. • ...given us gift cards to purchase the best educational apps.
School Support	6	• In-school training • Staff PD
Conferences	7	• IDEAS Conference - https://werklund.ucalgary.ca/ideas/ • Early Childhood Education Conference - https://ecec.teachers.ab.ca • iPad Conference - http://www.ipadconference.org/

Table 5. Professional learning opportunities in the ELT-RCOP

Comment Category	Sample Comment(s)
Networking and building connections in a research community of practice	• It has also been beneficial to have other people providing ideas for future growth/directions in the project. • All very helpful for networking, collaborating, communication and building clarity regarding my focus and where I can go next with my project.
Collaboration	• Working with another teacher on a similar project. • Collaboration with other colleagues.
Partnerships with mentors and researchers	• Planning days with experts on planning process - help to clarify and make plans for a project • I always feel very inspired after our meetings. The Ideas conference was also very inspiring. I really love how you share the research with us. • Inquiry project planning with Galileo [mentors] was VERY helpful. • Planning days with K-4 technology community of practice • All of the ELT-RCOP meetings have been helpful to share ideas and see what others are thinking/doing and also in providing a framework for developing and evaluating use of technology within our projects.
Creating and sharing with others	• Helpful to see the process that other people went through sharing of apps - no need to reinvent the wheel. • Working with others on the development of my ideas. Two heads are always better than on. Listening/working with others who have more experience with technology. • Bi-annual community of practice meeting with all people involved in the project. These have been very useful as we have been able to share our ideas and experiences with others • I intend to work more with my teaching partner…
Ongoing learning and improvement	• Exposure to some peer reviewed research papers and books. It is always encouraging and helpful to read/hear short summaries, and then go away for further study. • Great peer feedback to improve and enhance our projects.

days as well as exposure to professional readings, video clips and exemplars of generative topics. Other professional learning opportunities listed by respondents included accessing district or school level supports, attending conferences, undertaking graduate studies, assessing vendor training and participating in social media networks (i.e. Twitter).

Overall, comments gathered from annual surveys, interviews and feedback from ELT-RCOP events indicated strong professional and personal investments in the work of this initiative, such as the following reflection:

As a teacher, I felt that this process has focused my practice. It helped me to define some of my own learning in a more refined way. Having access to other professionals and researchers from around the province gave me the opportunity to grow in my knowledge and clarify my thinking about what is important in teaching and learning . . . . PD that is sustained, focused, and socially-based is transformative. The research process allows us to find a starting point and continue moving forward. [Participant G]

School jurisdictions provided ongoing support and leadership for this initiative by making provisions for project leads, consultant support, additional teacher release time, field trips, accessing external experts and frequent showcasing and celebrating students' and teachers' work. For example, in some jurisdictions a district-level leader (administrator, specialist or consultant) worked with teachers involved in the initiative. Teachers were provided with release time to meet during the day and groups would meet on regular basis in addition to the bi-annual ELT-RCOP meetings to plan and share projects. District leaders

were also actively involved in the ELT-RCOP meetings and contributed to data collection by responding to surveys and participating in interviews and focus groups. Likewise, school-based leaders (principals, assistant principals) also attended the ELT-RCOP meetings and provided support and encouragement to the teachers in their schools. Teachers appreciated and valued leadership support and encouragement to take risks in teaching and learning and for supporting use of technology with young learners.

CONCLUSION

Over the course of this case study, several innovations in teaching practices were made possible through professional learning that was grounded in research, sustained over time and socially enriched within a research community of practice (RCOP). Teachers valued using research-informed, instructional frameworks to support learning task design. Throughout the initiative, teachers were engaged in a process of using elements of worthwhile work and appropriate use of technology to analyze their own task designs and designs of others. Finally, the social construction of knowledge by young learners and by teachers was promoted through technology. This study demonstrates that professional learning for teachers that is grounded in research, sustained over time and socially enriched within a community of practice can enhance teacher's practice. Over the course of the project there was an increasing understanding and application of the elements of worthwhile work and appropriate uses of technology, and teachers' facility in designing tasks containing these characteristics improved. Teachers were supported through a community of practice and students also become their own learning community. Students shared their work in the classroom and beyond the classroom walls in digital spaces as they learned how to access expertise outside of the classroom and co-construct and collaborate with others. It was evident the social construction of knowledge was promoted through technology. Opportunities for collaboration and the quality of professional learning were particularly appreciated by teachers and school leaders. School jurisdiction support for this initiative were uniformly strong with ready access to consultants, additional teacher release time provided, ready access to technology and networks, and frequent showcasing of students' work.

The outcomes of this research are significant locally by impacting teachers and learners in schools in four school jurisdictions, as well as generally to the fields of teacher education, the learning sciences and to educational research more broadly for illustrating the relationship between ongoing, continuous professional learning for teachers in communities of practice, and the discipline rich, inquiry-based learning environments that leverage mobile and networked technology to increase intellectual engagement of young learners. The synthesis of extensive data gathered and analyzed over a two year period, including surveys in year one and year two of the study, classroom observations, interviews, focus groups, review of teacher designs carried out during the initiative, and other qualitative field notes and documentation identify specific factors, such as worthwhile work and appropriate use of technology, that assist in developing richer understanding of the types of technology enabled learning environments for young students being called for in the current research literature, and the types of professional learning that support teachers in making changes to their teaching practices. Furthermore, the outcomes are also significant more broadly to educational research scholars as this study informs future study and examination of relationships between professional learning involving a research community of practice with mentors and the collaborative development and analysis of discipline rich, inquiry-based, technology-enhanced learning environments sponsoring intellectual engagement and deep learning for young learners.

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KEY TERMS AND DEFINITIONS

Authentic Assessment: The documentation and measurement of learning that is worthwhile, complex, robust, significant, and meaningful, in contrast to multiple choice standardized tests or short-answer questions.

Designs for Learning: The design of learning opportunities and experiences for learners that shift the focus from standardized delivery and testing of content to technology enabled learning environments supported by participatory pedagogies that promote active learning and intellectual engagement.

Early Years Education: Formal learning experiences for children in kindergarten (age 5) to grade four (age 9 – 10 years).

Intellectual Engagement: An absorbing, creatively energized focus resulting in a deep personal commitment to exploration, investigation, problem-solving, and inquiry, maintained over a sustained period of time

Professional Learning: Formal and informal opportunities for educators to improve their practices, to develop new perspectives on teaching, learning and education, and to collaborate with other teachers and leaders to build knowledge.

Technology-Enabled Learning Environments (TELEs): Change how learners and teachers learn, collaborate, play, socialize, access resources and services, and connect; leveraging social and digital technologies, TELEs enable learners to participate in online and local communities to share and exchange ideas, to view and peer review each other's expressions and creations, to contribute to and build upon each other's work, to work collaboratively to improve ideas, and to design, develop, implement, assess, and discuss ideas, strategies, goals, solutions, and ideas.

Young Children: Children from age 5 to age 10.