A Canadian Perspective on Teaching Technology

David Gill

This paper will present the second in a series of case studies on teaching technology education within the Newfoundland and Labrador, Canada context. Specifically, this paper will discuss what is helping and hindering the teaching of technology education and skilled trades at the secondary level (grades 10-12) in relation to a previous intermediate level (grades 7-9) case study. Intermediate technology education is marginalized in relation to other areas of the general curriculum within the Canadian context. As such, this research study sought to understand if marginalization and other related themes were present at the secondary level. The Technology Education Teaching Framework (TETF) which emphasizes the role of teacher experience, professional development, and leadership was used as the primary lens of inquiry. A qualitative case study methodology framed this study. Data were collected via an online questionnaire, semi-structured interviews, and classroom observations from a purposeful typical within case sample of Canadian technology education and skilled trades teachers. Two cycle coding was used in conjunction with thematic analysis to analyze and interpret the data. Secondary technology education and skilled trades teachers share similar beliefs and pedagogical practices as their intermediate counterparts. Themes of professionalism and systemic marginalization emerged as helping and hindering teachers' efforts. However, at this level there was an identified tension between the values associated with the technology education and skilled trades curricula. Moving forward, raising the profile of technology education is framed within the potential transferability of local strategies and solutions to other jurisdictions with similar circumstances.

Keywords: technology education, teaching, values, curricular marginalization, teacher professionalism

Throughout technology education's relatively short history, one theme has remained constant: misunderstanding. Multiple educational trends, such as Science, Technology, and Society (STS), Science, Technology, Engineering, and Math (STEM), the maker movement, and calls for the inclusion of computer science in the general curriculum have continued to obscure technology education (Cheek 2000; Fasso and Knight 2019; Fox-Turnbull 2017; Wells 2008). These competing interests in the spheres of technology and education have continued to have an impact on the reality of practitioners tasked with teaching technology education.

Local Context

From a Canadian perspective, research into classroom based barriers and supports for the teaching of the intermediate (grades 7-9) Newfoundland and Labrador technology education program has revealed a paradox between public opinion about the importance of technology, and actual support for the mandated curriculum (Gill 2018). Gill's (2018) case study on the teaching of Newfoundland and Labrador intermediate technology education concluded that there was evidence of systematic marginalization. This marginalization took the form of inconsistencies in access to space and resources, less social capital, a lack of formalized leadership at the school district level, and misaligned professional development opportunities (Gill 2018). Although these findings are specific to the local context they also align with similar findings related to teacher experience (Hynes 2012), professional development (Jarvinen, Hintikka, and Karsikas 2008), and leadership (Copeland and Gray 2002) within an international scope. While marginalization exists, teacher professionalism, through personal development and collegial networks, was also highlighted as an important support mechanism (Gill

2018). To grasp a deeper understanding of the Newfoundland and Labrador system as a whole, a case study on the secondary (grades 10-12) technology education program was developed. At the time of this case study, there were ten courses available to secondary students in the province. In contrast to the intermediate program, at the secondary level, these ten courses are divided into two sub categories: technology education (4 courses) and skilled trades (6 courses).

Theoretical Framework

As this current study on teaching Newfoundland and Labrador technology education and skilled trades followed the methodological approach of the previous intermediate case study, the teaching framework that emerged out of that study was used as the primary lens of inquiry. The *technology education teaching framework* (TETF), as illustrated in Figure 1, describes the relationship between a technology teacher's experiences, professional development opportunities, and leadership interactions and their teaching of the technology curriculum (Gill 2018).

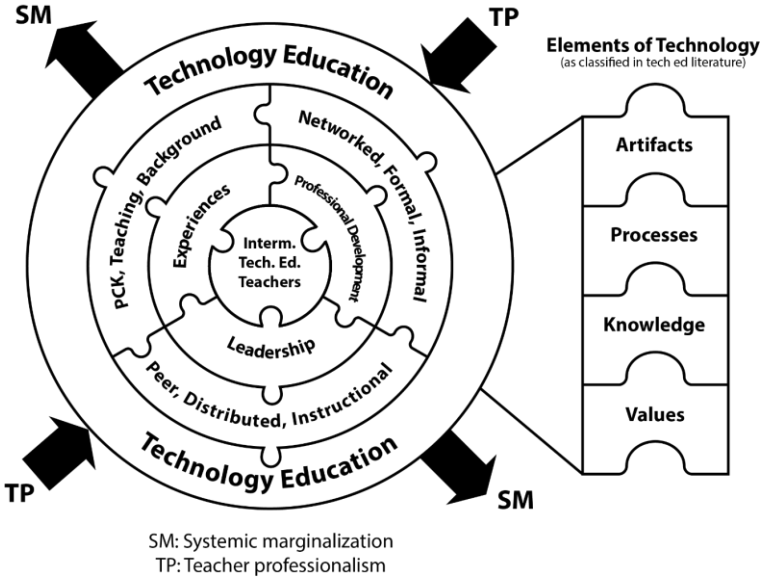

Figure 1. Technology Education Teaching Framework

The interlocking puzzle pieces represent the interconnection of these schematic areas in relation to teachers' perceptions of technology education and the idea of technology being associated with artifacts, knowledge, processes, and values (Mitcham 1994; de Vries 2016). The opposing arrows on the outside of the framework represent the larger forces of systematic marginalization and teacher professionalism that hold the system together. An individual teacher's understanding and their actualization can be viewed as a complex balance between the internal and external pressures represented in the TEFT. As such, this framework was used to examine the views of secondary teachers and if there were any significant differences compared to the current conceptualization. Gaining a contemporary understanding of teachers' conceptualizations of their own pedagogical approaches, technology, and technology education within local systemic constraints is key for gaining insight into the relative strength of any technology education curriculum (Jones et al. 2019). Therefore, this case study was positioned to increase our empirical understanding of teaching technology education from a secondary Canadian perspective.

Purpose of Study

The purpose of this study was to explore the teaching of secondary technology education and skilled trades within the Canadian context. In particular, this investigation sought to understand teachers' perceptions related to their experiences teaching secondary technology education and skilled trades, professional development opportunities, and the leadership and other support structures available that may help and/or hinder their teaching. The study's main research question asked what factors support or hinder the capability and capacity of secondary technology education and skilled trades teachers in Newfoundland and Labrador? Sub-questions on teachers' experiences and beliefs, professional development opportunities, and leadership supported the investigation.

Methodology and Methods

This inquiry was positioned within the qualitative/constructivist paradigm, and in particular, the case study methodology based primarily on the methodological articulation of Merriam and Tisdell (2016). A questionnaire, interviews, and classroom observations formed a purposeful typical within case sample of the teaching and administrative population of technology education and skilled trades teachers within the Newfoundland and Labrador English School District (NLESD). Six phase thematic analysis based on the work of and Braun and Clarke (2006) was used to explore and develop a rich thick description of the experience of teaching secondary technology education and skilled trades. Braun and Clarke (2006) emphasize that thematic analysis is a foundational qualitative method that can work within multiple epistemological frameworks. For this study their six phases were followed as a way for themes to emerge from the data. Each phase is briefly outlined below:

1. *Phase one:* includes the initial reading of the entire data set.
2. *Phase two*: aligns with first cycle coding of data chunks into themes.
3. *Phase three*: is the sorting of initial codes into thematic groups.
4. *Phase four*: focuses on reviewing all identified themes and re-coding if necessary.
5. *Phase five*: deals with the consolidation, defining, and finalization of the theme names.
6. *Phase six*: is the actual writing of the report.

The NLESD is the larger of two school districts in the province, both in terms of student population and geographic area. The online questionnaire was distributed across the entire province in the fall of 2017 and was primarily used to identify suitable candidates for interviews and potential classroom observations. To maintain a typical case, teachers had to have three or more years of consecutive experience, be currently teaching in the area, and work within the Avalon Peninsula. Ten teachers (eight male, two female) with a wide range of experience and education were selected as participants. These teachers represented every geographical region of the province, with the exception of Labrador, and had between five to over 25 years of experience. The teachers also reported teaching an even representative sample of the existing 10 technology and skilled trades courses offered in Newfoundland and Labrador. Five teachers reported having formal education in technology education.

Analysis and Findings

While the larger case study utilized an online questionnaire, interviews, and classroom observations, due to the limited nature of this paper the findings will focus on a preliminary analysis of the teacher semi-structured interview data. All interviews were digitally recorded and transcribed with the teachers' permission.

Experience and Belief

When teachers were asked about their experiences and beliefs concerning technology a very consistent message emerged from the data. Within the framework of Mitcham (1994), and the further articulation of de Vries (2016), technology can be viewed from a complex and complementary perspective of artifacts, knowledge, processes, and values. It was from this position that teachers' experiences and

beliefs regarding technology and technology education were gauged. Two distinct themes emerged from the data, first that secondary technology education and skilled trades teachers perceive and believe that technology is a multi-faceted phenomenon. Second, there is almost no explicit discussion concerning the value laden aspects of technology.

When asked to describe their thoughts on the nature of technology, seven of the 10 teachers described a multi-faceted phenomena by using words like: "relationship", "philosophy", "process", "tool", "idea", "knowledge", and "problem-solving". Within their collective thoughts, these seven teachers painted technology as much more than a final artifact, but as a way of thinking, doing, and problem solving for the benefit of individuals and society. This idea of technology as a form of knowledge was illustrated when a teacher said: "We look at how it's not necessarily a physical object, but a concept or an idea." Other teachers talked about how technology was a "problem-solving process" and that our interactions with artifacts and tools were just a part of a larger ongoing relationship between humanity and our technological creations. The remaining three teachers focused almost exclusively on technology as tools, with little to no discussion beyond that point. While the idea of a larger relationship surfaced, the idea of technological values was almost non-existent.

With the exception of one teacher talking about a larger relationship between humans and technology, the only other explicit mention of technological values was one teacher's description of how she introduces her students to the idea of how technology may make things "easier." She went on to say that easier could be interpreted to mean making things "faster, safer, nicer to look at…" and that "easier doesn't necessarily have to mean that it's easy because some technology is very complicated, but it's improved their lives in some way." The reference to "nicer" underlies the role of aesthetic value that is imbued in all technological artifacts, while the idea of making life better also brings to mind the explicit and implicit ethical implications of technological systems. This superficial treatment of the value laden aspects of technology is also reflected in the dismissal of technology as "just a tool" which may be a partial explanation for the lack of deeper consideration and systemic curricular marginalization illustrated through the professional development experiences of the participants.

Professional Development

The qualities of effective professional development have been well researched and documented over the last three decades. Darling-Hammond, Hyler, and Gardner (2017) defined professional development as "… structured professional learning that results in changes in teacher practices and improvements in student learning outcomes." (p. v). Through an analysis of the data, two major themes emerged in relation to teachers' experience and expectations of professional development for secondary technology education and skilled trades that may not match the definition above. First, there was a significant focus on the self-directed and self-organized nature of professional development within the NLESD. Second, a lack of support and organizational barriers to effective professional development also emerged.

Self-directed and teacher led organization of professional development was a significant theme in the data. All 10 teachers mentioned participating in their own self-directed professional development and six teachers talked extensively about their roles in planning and facilitating professional development for their peers. Some teachers questioned the imposition and balance between their work and family life that this placed on them. This idea is illustrated when a teacher stated: "So, if I'm spending 5 hours a week doing personal professional development; and by personal, I mean… on my own time. That's 5 hours of family time that's being cut into". Balancing time was a recurring theme and was sometimes related to the use of online resources. Apart from online communities, personal connections also played a large role in self-directed professional development. Either networking with peers at a local level or at various face-to-face opportunities, the idea of forming a peer network was strongly linked to self-directed professional development. It was a point of frustration for well-established teachers that they are typically called on by their employer to facilitate professional development for transient teachers but are seldom offered any advanced sessions for themselves. As one teacher stated, "I don't know if I –

aside from the first summer institute… I don't know if I've received any PD from the District or Department, I've only given PD" and he wondered "… what kind of PL I could expect at this point, ah, because I've been trying to push the envelope". While there were some positive comments on the experience of providing professional development for peers, there are still questions about the lack of formal support.

The second theme related to a lack of formal support and organizational barriers to effective professional development. In particular, a lack of financial support, restrictive regulations, and a lack of knowledgeable leadership were highlighted as hindering professional development. One teacher mentioned that it was becoming very difficult to secure funds for substitute teachers, thus making professional development less accessible. This teacher speculated that technology education's "lower priority" than other core courses was probably an influencing factor in these restrictions. Another teacher mentioned that when new curriculum was implemented"… there was a lot of training, but, ah, afterwards when the money is gone, of course, that dwindles off". The NLESD's decision to stop a teacher planned session due to a regulation restricting third party involvement was described as absolutely infuriating by one participant. School district specialists with a lack of expertise was another concern emerging from the data. This was confirmed by one teacher when he was talking about how the district had lumped science, math, and technology as a single support position and that the individual "… can't really offer a whole lot in terms of knowledge on the tech side of it". This situation may explain why many participants described formal district professional development as "irrelevant", "too short", "repetitive", and as a venue for "complaint sessions". While there are formal and informal opportunities available, they are typically either self-directed or self-organized, as there is no knowledgeable systematic technology education leadership within the local context.

Leadership

When ambiguity and a lack of formalized leadership are central themes within the educational structure of jurisdictions that offer technology education, it can increase feelings of disillusionment and isolation among teachers (Gill 2018). On the other hand, when there is a well-established, knowledgeable, and supportive formalized leadership structure this can strengthen a sense of community and common goal orientation among teachers (Copeland and Gray 2002). Within this context, two themes emerged from the data concerning teachers' views on technology education and skilled trades leadership. First, there was strong consensus among the study's participants that there was a serious lack of formalized leadership from the NLESD. Second, an equally strong consensus emerged that the most effective leadership was peer oriented and at the local administration level, but that this type of leadership was ad hoc, haphazard, and very much context dependent.

Within the Newfoundland and Labrador context, teachers' first contact with school district support for curricular matters falls to a network of program specialists. Program specialists are responsible for coordinating professional develop, new curriculum delivery, and general curricular support for teachers within their area of expertise. While teachers explained that curricular areas such as Math or Language Arts typically get dedicated program specialist supports, technology education and skilled trades are usually add-ons to another program specialist's portfolio. This phenomenon has caused a discontinuity among technology and skilled trades teachers, as one participant noted "… there's zero communication on technology issues, curriculum, program issues, ah, directly. Zero questions, zero monitoring, zero investigation. So, it's kind of pray to God". These feelings of isolation and lack of systematic knowledgeable support were summed up when a veteran teacher said, "we're not even an afterthought, we're simply a line on a signature in an email …". While this lack of leadership was highlighted, teachers also noted the systemic issue and connection between a lack of a fundamental understanding of technology education and skilled trades at higher administrative levels and why there is such a limited focus on providing expert program specialist support. As one teacher put it, the Senior Education

Officers, Assistant Directors, and other executive administration of the school district think of technology education and skilled trades as "… an afterthought. So, they generally, they don't know what it is, or don't understand completely what it is, but nowhere are incentives or bothered to figure out what it is". With a clear lack of curriculum leadership coming from the NLESD, informal networks of teachers supported by their local administrations also emerged as a prominent theme throughout the data.

Words and phrases such as "implicit", "informal", "grassroots drive", "community", "tough", and "isolated" were reoccurring throughout the data when the idea of peer and local leadership was discussed. From a local school level, there was a general consensus that a principal's support was essential, and in most cases, there were reports of positive relationships. As one teacher put it: "If you've got a principal in your school who's supportive of your program and, ah, what you're doing in your classroom, I think that benefits a teacher greatly". The idea of a disjointed community emerged from the data as teachers talked about their experiences. As one teacher put it, there are small "clusters" of technology education and skilled trades teachers that work together, but they are isolated from a larger community. Teachers typically find each other in an ad hoc manner and form support networks within their personal context, but again there is no sense of an extended organized community of practitioners. While the curriculum exists, there continues to be a large gap in direction and guidance from a systemic perspective.

The juxtaposition of local supportive administration against a backdrop of inadequate school district support is only highlighted by teachers' own attempts to support each other. This haphazard organization may be one reason for the friction between technology education and skilled trades that was apparent from a continued analysis of the data.

Technology or Skilled Trades?

Much has been written and researched concerning the identity of technology education within the construct of general education (Foster 1994; Haché 2007; Hill 1997; Jones, Buntting, and de Vries 2013) The tensions created by the emergence of technology education from vocational, craft, and skill based education still exists in many jurisdictions and was evident from an analysis of the Newfoundland and Labrador data. This tension is not captured in the existing TETF, but is worth considering as a new construct within the model to better capture general constraints and supports within technology education teaching. Two general themes emerged from the data in relation to the tension between technology education and skilled trades within the local context. First, a division between the status of technology education and skilled trades. Second, there is still a general misunderstanding within parent and student populations between technology education and skilled trades courses.

While most teachers noted similarities between technology education and skilled trades courses from a theoretical perspective, this typically disappeared when the conversation turned to practical implementation. A recurring theme throughout the data was the idea that skilled trades were "task-oriented" and do-this types of courses, whereas technology education were process-oriented and design-this types of courses. This was illustrated when a teacher was talking about the evaluation methods for skilled trades courses when he said, "even the way the weightings of the curriculum guide gives, you know, it stresses the product as opposed to the process". This difference in status also related to the idea that there was a general lack of understanding of technology education compared to skilled trades.

Teachers reported that there was no need to explain the content and activities related to skilled trades courses, whereas there could be a barrier to students' understanding what other technology related courses entailed. As one teacher put it, "so, a student that comes into design and fabrication course, often times doesn't really know what they're signed up for…" and that "…it seems like the more technical courses, they don't really know what they've signed up for, but the trades courses, they at least have some concept…" This type of familiarity with a trades based context, due to the prevalent cultural

employment norms, can also manifest into skewed local offerings of courses based on resources and teacher expertise. As one teacher mentioned, he was aware of some sizable schools that did not offer either the secondary robotics course or any of the communication courses but did offer the whole suite of skilled trades courses. He went on to question how this could happen, but later reflected that "they may have had someone, you know, well suited to skilled trades, but not to the computer technology side of it and that's what they built upon".

Internal divisions and the general publics continued misunderstanding about the nature of technology education and skilled trades was highlighted in the data. These issues can be viewed as a hindering factor for secondary technology education and skilled trades teachers within the Newfoundland and Labrador context.

Discussion and Conclusion

The findings from a preliminary analysis of secondary teacher interview data would suggest a strong thematic alignment with the initial case study on intermediate technology education teachers within the Newfoundland and Labrador context. This would include similar finding about teachers' beliefs and views on technology, and technology education, a deficit in appropriate professional development opportunities, and a lack of school district support. It is also worth noting the similarities between intermediate and secondary teachers in identifying informal peer networks and local administrators as primary support mechanisms in their teaching. One significant difference at the secondary level was the emergence of teachers' feelings of disciplinary ambiguity caused by the administrative split between technology education and skilled trades at the curriculum level.

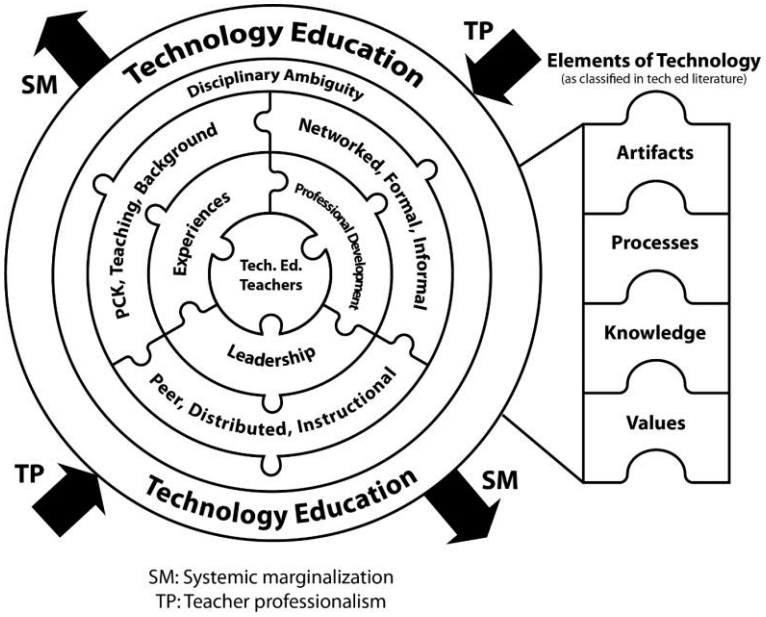

Figure 2. Modified TETF

As such, it is warranted to include this disciplinary tension in a modified version of the TETF. Figure 2 outlines this modified TEFT by adding one ring before technology education. This addition signifies that there can be a layer of disciplinary ambiguity when teachers are working out their own conceptualizations of technology education. By continuing to look at the specific within the boundaries of rigorous case studies on the teaching of technology education, we can start to see patterns that may describe the supports and constraints of teaching this subject within a wider general context. It would be interesting to see if the patterns captured in the modified TEFT could be found in other educational jurisdictions with similar contexts as it may help in addressing inadequacies in support and curriculum delivery.

References

Braun, V.,& Clarke, V. (2006). "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology 3*(2):77–101. doi: 10.1191/1478088706qp063oa.

Cheek, D. W. (2000). "Marginalization of Technology within the STS Movement in American K-12 Education." pp. 167–92 in *Science, Technology, and Society: A sourcebook on research and practice*, *Innovations in science education and technology*. New York: Kluwer Academic/Plenum Publishers.

Copeland, L. & Gray. R. (2002). "Developing Maryland's Technology Education Leaders for the 21st Century: Technology Education Leadership Project (TELP)." *Journal of Industrial Teacher Education 39*(3):104–21.

Darling-Hammond, L. Hyler, M. E. & Gardner. M. (2017). *Effective Teacher Professional Development*. Palo Alto, CA: Learning Policy Institute.

Fasso, W. & Knight B. A. (2019). "Identity Development in School Makerspaces: Intentional Design." *International Journal of Technology and Design Education*. doi: 10.1007/s10798-019-09501-z.

Foster, P N. (1994). "Technology Education: AKA Industrial Arts." *Journal of Technology Education* 5(2).

Fox-Turnbull, W. (2017). "Implementing Digital Technology in the New Zealand Curriculum." Pp. 441–67 in *Research and practice in technology education: Perspectives on human capacity and development*, edited by N. Seery, J. Buckley, D. Canty, and J. Phelan. Athlone, Ireland: Athlone Institute of Technology.

Gill, D. (2018). "A Technology Education Teaching Framework: Factors That Support and Hinder Intermediate Technology Education Teachers." *International Journal of Technology and Design Education*. doi: 10.1007/s10798-018-9465-0.

Haché, G. J. (2007). "Revitalizing Technology Education with Apprenticeship Studies." Pp. 347–52 in *Teaching and Learning Technological Literacy in the Classroom*, edited by J. R. Dakers, W. J. Dow, and M. J. de Vries. Glasgow: Faculty of Education University of Glasgow.

Hill, A-M. (1997). *Reconstructionism in Technology Education*. Springer.

Hynes, M. (2012). "Middle-School Teachers' Understanding and Teaching of the Engineering Design Process: A Look at Subject Matter and Pedagogical Content Knowledge." *International Journal of Technology and Design Education 22*(3):345–60. doi: 10.1007/s10798-010-9142-4.

Jarvinen, E-M, Hintikka, J. & Karsikas, A. (2008). "DEPTH–Developing Professional Thinking for Finnish Technology Teachers." *International Journal of Technology and Design Education 18*(3):265–73. doi: 10.1007/s10798-008-9052-x.

Jones, A, Buntting, C. &. de Vries, M. (2013). "The Developing Field of Technology Education: A Review to Look Forward." *International Journal of Technology and Design Education 23*(2):191–212. doi: 10.1007/s10798-011-9174-4.

Jones, L. C., McDermott, H. J., Tyrer, J. R., &Zanker, N. P. (2019). "The Effect of Teacher's Confidence on Technology and Engineering Curriculum Provision." *International Journal of Technology and Design Education*. doi: 10.1007/s10798-019-09542-4.

Merriam, S. B., & Tisdell, E. J.. (2016). *Qualitative Research: A Guide to Design and Implementation*. Fourth Edition. San Francisco, CA: Jossey-Bass.

Mitcham, C. (1994). *Thinking through Technology: The Path between Engineering and Philosophy*. University of Chicago Press.

de Vries, M. J. (2016). *Teaching about Technology: An Introduction to the Philosophy of Technology for Non-Philosophers*. 2nd ed. Springer International Publishing.

Wells, J. G. (2008). "STEM Education: The Potential of Technology Education." in *95th Mississippi Valley Technology Teacher Education Conference, St. Louis, MO*. Vol. 41.

David Gill is currently Assistant Professor of Technology Education at Memorial University of Newfoundland, Canada. He is a former technology education teacher and is the recipient of multiple provincial and national awards for teaching, professional development, and research. His current research focuses on technology education in the Newfoundland and Labrador context, makerspaces, design, and the K-12 learning environment, and expertise and the development of technical skills and pedagogical content knowledge.