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Barriers to Systemic, Effective, and Sustainable Technology Use in High School Classrooms

Obstacles à l'utilisation systémique, efficace et durable de la technologie dans les salles de classe des écoles secondaires

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Abstract

The purpose of the Technology and High School Success (THSS) initiative was to encourage innovative strategies focused on improving provincial high school completion rates, using technology and student-centered learning to engage student interest. The primary purpose of this paper is to report on barriers that impede systemic, effective and sustainable technology integration within schools. Even with teacher and administrative support and commitment for THSS, evaluative research indicated minimal change in system capacity as a result of the initiative. Three primary barriers to program sustainability were: 1) schools and school districts did not leverage the opportunity to revisit their existing vision(s), 2) schools and school districts did not use data to make changes, and 3) limited access to technology.

Résumé

Le but de l'initiative « Technology and High School Success (THSS) » était d'encourager des stratégies novatrices visant à améliorer le taux d'achèvement des études secondaires dans la province de l'Alberta en utilisant la technologie et un apprentissage centré sur l'élève afin de susciter l'intérêt des élèves. L'objectif principal de cet article est de rendre compte des obstacles entravant l'intégration systémique, efficace et durable de la technologie dans les écoles. La recherche évaluative a révélé des changements minimes dans la capacité systémique à la suite de l'initiative, et ce, malgré l'appui et l'engagement des enseignants et des administrateurs envers le THSS. Les trois obstacles principaux à la viabilité du programme sont les suivants: 1) les écoles et les districts scolaires n'ont pas profité de l'occasion pour revoir leur(s) vision(s), 2) les écoles et les districts scolaires n'ont pas utilisé les données pour effectuer des changements, et 3) l'accès limité à la technologie.

Introduction

Research has shown that people learn best when trying to do things that are challenging and of deep interest to them, reflecting the close interplay of affect and cognition in the development of capacity (Csikszentmihalyi 1990, 1997; Jacobsen, Friesen & Saar, 2010; Kuh, 2001, 2003; Willms, Friesen & Milton, 2009). A recent Canadian study (Willms, Friesen & Milton, 2009) provides compelling evidence that schools differ considerably in demonstrated levels of student engagement, and that differences among schools have less to do with students' backgrounds than they do with school policies and practices, and in particular, the learning climate established by teachers in the classroom. For example, Means, Toyama, Murphy, Bakia, and Jones (2009), in a meta-analysis of over 175 studies, claimed that blended learning environments produced stronger learning outcomes than did classes with in-person teacher instruction. In many of these situations, student-directed, interactive, and collaborative learning experiences were more effective than teacher-directed, whole class instructional methods alone (Lee, Linn, Varma & Liu, 2010; Jacobsen, 2010; Means, et al., 2009). It might be tempting to suggest from findings like these that it is the introduction of technology itself into the classroom that is responsible for the stronger learning outcomes; however, the reality is likely more nuanced.

Major technology initiatives are not uncommon in K-12 environments, where funds are provided for buying various types of instructional technology in the hopes of providing transformational experiences to students. In many of these cases, the approach often seems to consist of trying to place as much technology as possible in schools in the hope that teachers and students will derive some benefits from the technology simply by its addition (OECD, 2010). Yet, despite the number of these projects and the expected benefits of using technology in the classroom, the hoped for transformations do not always take place (Cuban, 2006). When transformation does take place it is usually limited, incremental, and variable, perhaps having more to do with general teaching practice than technology use (Weston & Bain, 2010). Given the time and resources required for systemic change, the lack of sustainability can prevent projects ever reaching scale. So every time a new technology related initiative begins the process often starts over from the beginning (Law, 2009).

In 2007 the provincial government of Alberta, Canada issued a Call for Proposals to all publicly funded school districts and charter schools for the purchase of technology and to demonstrate how the innovative use of technology could improve the student learning experience at the secondary level (mostly grades 9 through 12). In total, 24 school districts and/or charter schools were successful in receiving funding. As part of this initiative each school district was required to conduct its own research project. In addition, the authors were contracted to conduct a macro-level, provincial evaluation of the initiative during the final two years of the project (2008-2010) and to provide information back to the government and the public regarding the general results of the program. A key component in understanding how technology can be used to increase student success is to gather information regarding barriers to systemic, effective and sustainable technology integration. In this paper we present selected findings and implications from this macro-level evaluation of the provincial initiative examining the link between technology and high school success.

Method

Data Collection

We used a mixed method case study approach for this study. A mixed methods approach was employed for two reasons: triangulation which increased convergent validity through the use of multiple measures of similar underlying concepts; and complimentarity which means that different aspects of what was being examined could be evaluated using different methods (Green, Caracelli, & Graham, 1989). Because the phenomena of interest in this investigation were complex (23 school districts involving over 22,000 students and 420 teachers at over 70 schools) we needed a range of research methods to capture and describe the complexity of each case, and to facilitate cross-case synthesis and explanation building (Yin, 2006).

We collected data from three sources: (1) online surveys, including a student engagement survey, a student technology use survey, and a teacher technology use and educational practice survey; (2) interviews and focus groups with students, teachers, team leads, technical support staff, school administrators, and district administration; and (3) field notes and classroom observations from site visits to the school districts.

Data Collection and Analysis

Data were collected throughout the 2 years of the macro-level evaluation of the program, from September 2008 to June 2010. All qualitative data were processed through an iterative process of reading, rereading, coding and review. The two student surveys, assessing students' perceptions of intellectual engagement (based on "What Did You Do in School Today", Canadian Education Association) and students' perceptions of technology were analyzed quantitatively (n=2,433). Teachers completed surveys regarding their instructional planning and classroom practises (n=294). Eighty-two interviews and focus groups with students, teachers, support staff and administrators were coded and subjected to content analysis to discern patterns of experience and develop themes. Forty classroom observations focused on discipline, instructional practises, student engagement and student interactions. These observations were aggregated and analyzed using a combination of descriptive statistics and qualitative content analysis.

Participants

Of the 2,433 students who completed the survey, 47.7% were female and 50.5% were male (1.8% chose not to respond). All students were in grades 9 through 12 with the majority being in grades 10-12. Student focus groups were conducted with students in grades 9 through 12.

When teachers were asked about years of teaching experience, the most frequently selected category was more than 20 years (21.8 % of responses); however, responses were spread fairly evenly across categories of teaching years (less than 3 years – 13.3%, 3 to 5 years – 14.6%, 6 to 9 years – 18.0%, 10 to 14 years – 16.3%, and 15 to 19 years – 12.9%). Forty-three percent of teachers indicated that they have been using instructional technology in their classrooms for 2 to 5 years.

Results and Discussion

Data from the participating school districts were analyzed to determine the progress that the school districts, as systems, were making progress towards creating innovative learning environments (Friesen & Lock, 2010). The components for the system were derived from the research literature (Bransford, Brown & Cocking, 2000; Friesen & Lock, 2010; Hargreaves & Shirley, 2009; Jenkins, Purushotma, Weigel, Clinton & Robison, 2009; Lemke, Coughlin, Garcia, Reifsneider & Baas, 2009; OECD, 2006, 2008, 2009a, 2009b; Sawyer, 2006, 2008; Scardamalia & Bereiter, 2006; Scardamalia, Bransford, Kozma & Qyekknakzm, 2010). In examining the data, we identified three barriers that impacted school districts' and schools' abilities to realize systemic, effective, and sustainable technology use: (1) school districts and schools did not leverage the opportunity to re-examine their vision, (2) there was little evidence of school districts and schools using research evidence to inform or effect changes to their practice, and (3) access to effective technology was still a limiting factor. The focus, generally, seemed to be on acquiring technology and increasing the technological infrastructure rather than on investing in the human infrastructure and examining how that technology could be used most effectively to impact changed teaching practices and to create greater learning opportunities for students. Technology was often seen as the solution rather than a means to an end.

Re-examining Vision for Learning With Technology

When examined in aggregate, the survey and interview data indicate that many school districts are at a beginning level in formulating a contemporary shared vision that incorporates the new realities in teaching, learning, and leading. During interviews, school leaders and teachers often referenced jurisdiction planning documents; very few were able to describe how the jurisdiction goals for learning with technology were created, and no participant indicated that they had had a voice in developing the jurisdiction's vision for learning with technology. Interviews with jurisdictional leaders indicated that school districts are also at beginning levels in aligning the system to the new vision statements about learning with technology.

As part of this initiative, we visited schools within participating districts twice over the course of the research project. During each visit we observed classrooms to see how the technology was being used. The schools chose which classrooms and teachers we visited. We assume that they selected teachers whose practices were consistent with the school's perspective regarding technology use and who were considered successful at using technology in their teaching and for student learning. Based on our observations, it appears that the schools' perception of what the research was trying to document was visible and heavy technology use by teachers – which is what we saw and what students reported. We were invited into classrooms where teachers were using technology, but saw little evidence of technology being used in support of increased student engagement through teachers' use of innovative instructional strategies or practices.

One barrier to meaningful and authentic use of technology for knowledge building appears to be the assumption that all that needs be done is make technology available to teachers, to put it in classrooms and teachers will figure out the rest (Cuban, 2006; OECD, 2010; Weston & Bain, 2010). Another aspect of this barrier appears to be the enduring image of what successful technology use by teachers is – which is linked to an information delivery approach, versus a student centered, assessment for learning approach. So, what we observed was the values-in-

action; teachers selecting and controlling the technology and the content. What is not clear from our observations, though, is whether this is a limitation of the teachers understanding of best practices with technology for learning or the schools and the culture within which the teachers work.

In analyzing the different ways leaders, both district and school, had taken up both challenge and opportunity that this initiative presented them, it was noted that most district and school leaders adopted a fairly linear approach to a complex problem. The linear approach was marked by articulating or pointing to a vision and attempting, or not, to align this new initiative to a pre-existing vision. There was little evidence of systemic efforts to revisit or rearticulate the school district or school vision based on this new Technology and High School Success initiative. When we spoke to leaders and teachers very few could articulate the vision for the initiative and fewer still were able to connect actions they were taking with the goals and expected outcomes of the project. This approach appears not to directly address sustainability as it seems to assume that existing methods and approaches are adequate and, therefore, sustainability is not directly addressed.

It appeared that many school districts and schools did not leverage the opportunity that this project presented or saw the need to (at least initially) revisit their existing technology vision. As one teacher noted, expressing frustration regarding the lack of an updated vision, "…the fact that things like email sites and blogs and wikis are blocked by our jurisdiction from the beginning speaks to the vision that they seem to have, right?" Instead, many district and school level administrators reported that they viewed this project as an add-on. A few reported that they felt they were suffering from initiative overload in their school districts or schools and a project such as this one just added one more thing into an already overburdened list of initiatives. It should be noted, however, that all of the school districts in this project had volunteered to submit a proposal for this initiative; participation in THSS was not mandatory.

In some schools it appeared that there was a disjoint between who championed the proposal and the people who were charged with carrying it out. In a number of schools the person or people who championed the project were no longer directly involved. In others, there were issues and problems that took priority over the technology (but still impacted the effective use of technology). For example, one project leader felt that the project would possibly have not succeeded if he had not been there to champion it, "And if it wasn't for me, and I'm not tooting my own horn, but if I didn't push it, push it, push it, it probably wouldn't—I'm glad I didn't leave. It may have fell flat." The schools and principals were supportive, but there was often a gap between the verbal support and how this actually translated into meaningful professional development for teachers, and a robust and reliable technology infrastructure. This gap could be a systemic problem as changes in roles and responsibilities can be expected over the course of any project such as this one.

There have been many promises regarding the potential of technology to revolutionize education, to reach out to disaffected students and to provide a more level playing field for all children (Edwards, 2003). The reality in schools, however, has not always matched the hype. Though our research does seem to indicate that students felt that they had adequate access to technology in the classroom (see Figure 1), it was the teachers who were primarily using the technology; in most cases in teacher-led discussions (see Figure 2). Rather than the use of technology leading to

more student-centered or discovery learning to more directly engage student learning, it appears that the technology was being used to do the same things that teachers were already doing.

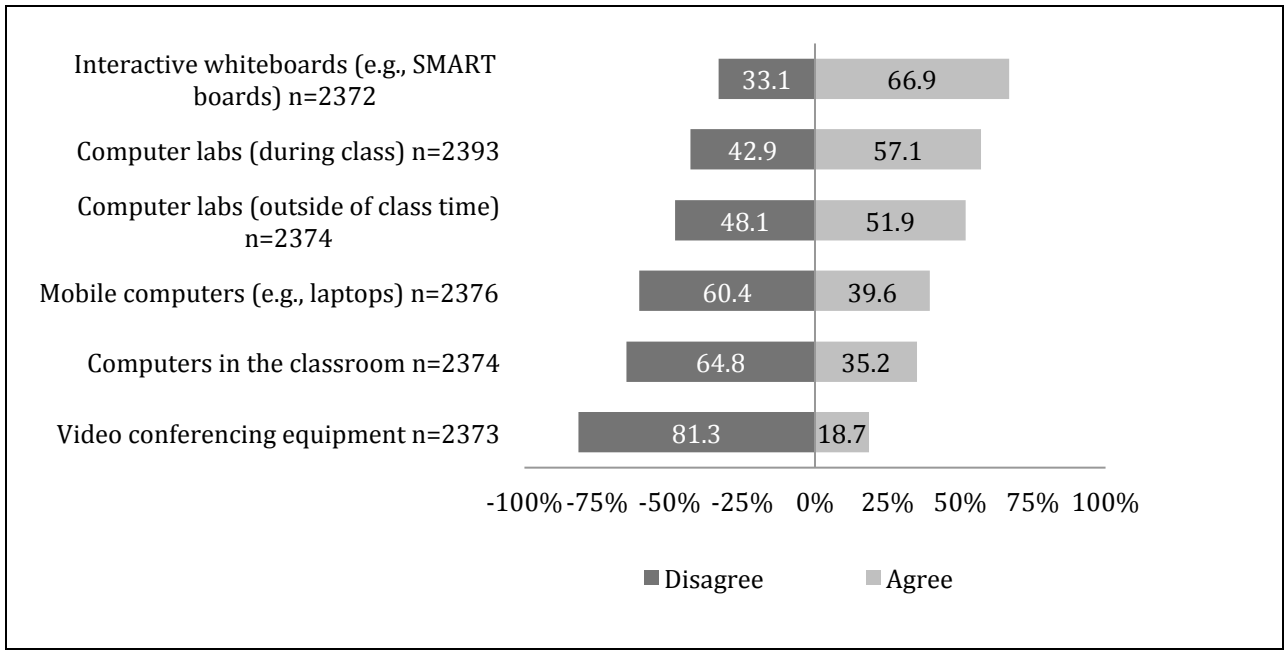

Figure 1. **Students' opinions regarding the adequacy of certain technologies in the classroom. Students agreed that they had adequate interactive whiteboards, but were less certain or disagreed regarding several other technologies such as mobile computers or computers in the classroom.**

Creating schools and school districts for today requires educators who are attuned to the demands of a knowledge society (OECD, 2010; UNESCO, 2005). Acknowledging this fact will mean that schools will need to broaden their focus from managing information exchanges to engaging learners, all learners—youth and adult alike—in collaborative knowledge building activities (Bransford, et al., 2000; Gilbert, 2005; Hargreaves, 2003; Hargreaves & Shirley, 2009; Jardine, Friesen & Clifford, 2006; Papert, 2004; Sawyer, 2008; Scardamalia & Bereiter, 2003; UNESCO, 2005; Wagner, 2006). From within school structures and processes designed to meet the needs of the industrial past, educational leaders are called upon to invent and design new learning environments and new education systems to address our contemporary society. As evidenced in this study, it is becoming clearer to many school districts and school leaders that simply adding technology to the current one-size-fits-all system will not get their school districts to where they need to go. Based on the one-size-fits-all perspective, it should not be surprising that some teachers and leaders see the technology as an add-on to their existing workload, rather than an opportunity to rethink practices and learning designs.

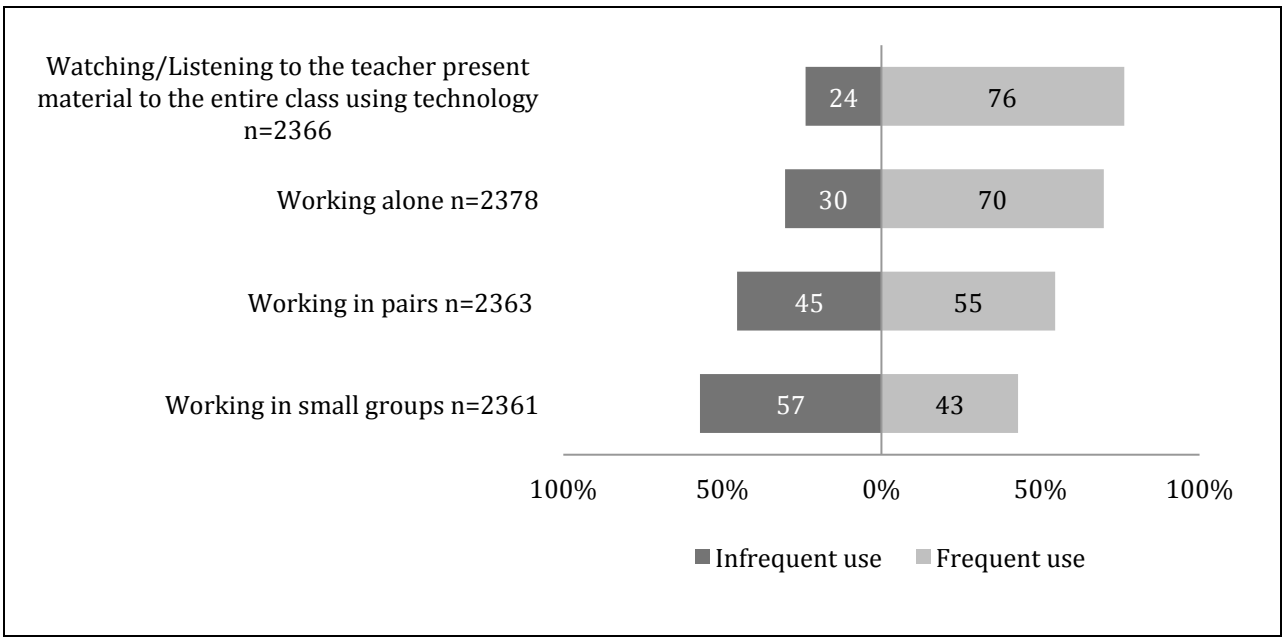

Figure 2. **Students were asked to indicate how and with what frequency technology was used in the classroom. Most students indicated that when technology was used in the classroom, it was most often used by teachers to present material to the whole class. Almost as frequently, students indicated that they used technology in the classroom when working alone.**

Evidence-based Practice

In this study, we found similar evidence to what has been found in other studies (e.g., Drill, Miller, & Behrstock-Sherratt, 2013); we found that while teachers and principals recognized the theoretical benefit of using research in their work, in practice, they were unlikely to use it. While it appeared from their comments that many of the leaders in the current study saw the need to collect evidence as the initiative unfolded (which was a requirement of the Provincial government funding), very few actually used the data they collected in any discernible way to inform the next steps of the initiative. As one district administrator indicated when asked whether there had been any attempt to evaluate the impact of the initiative, "We haven't done any real type of tests or anything to see—pretests, post-tests—to see have kids improved, not improved, stayed the same. We haven't done anything like that."

In a recent commentary, Baker and Welner (2012) advocate for the use of high quality research to increase productivity and efficiency in the educational system. Baker and Welner propose a national consortium to bring together high quality research for US schools. Despite advocates such as Baker and Welner, research data is still seldom used in education. Davies (1999) suggests two reasons why research has yet to find a foothold within education. First, "educational activity is often inadequately evaluated" (p. 109). Second, "research and evaluation studies that do exist are seldom searched for systematically, retrieved and read, critically appraised for quality, validity and relevance, and organized and graded for power of evidence" (p. 109). Based on interviews with jurisdiction and school leaders, and classroom teachers, the use of research to inform innovative uses of technology for learning, and the collection and use of data on the success of the initiative is ad hoc at best.

There are many potential benefits to effectively using research and data in education. For example, creating 21st century systems requires systems thinking. Twenty-first century systems thinking requires the system 1) to pay attention to what is emerging and evolving which necessitates collecting evidence along the way and making decisions informed by both research and evidence, and 2) to create structures and processes that are adaptable. These leaders understand at the deepest level that a knowledge-building organization is created through its connections and relationships, not its flowchart. Research can facilitate this process leading, potentially, to better, more informed decisions. A focus on research can also lead to a mindset of inquiry, not certitude. Using this approach, leaders could set in motion short-term processes towards the vision, collecting relevant and timely evidence at every step throughout the project, which they then use to monitor progress and create the next steps towards the vision, fully responsive to what was emerging.

Competencies and capacity to enact the changes required to make progress towards building the capacity for a 21st century system requires leadership practices for "knowledge driven organization[s] which demand innovation and creativity from all employees" (Murgatroyd, 2010, p. 4). An additional question that should be considered but was not part of this study is whether school districts and schools have the capacity to understand, interpret and use research findings even if research is being done; as was the case in this instance.

Recent efforts to use learning analytics may be an opportunity to begin to systematically incorporate data into teaching and learning. While this seems to be a move towards more evidence-based decision-making, there are still concerns regarding how this data is being used (Buckingham Shum & Ferguson, 2012). Simply having data is no guarantee that it will be used effectively. According to Booth (2012)

> ... even though learning analytics offers powerful tools and practices to improve the work of learning and assessment, well-considered principles and propositions for learning assessment should inform its careful adoption and use. Otherwise, learning analytics risks becoming a reductionist approach for measuring a bunch of "stuff" that ultimately doesn't matter. (Learning Analytics: The New Black, para. 2)

Access

Within this context, access to technology was found to be a limiting factor in effective use. Firewalls, content filters and Internet throttling constrain reliable teacher and student access to high quality online resources (see Figure 3 and Table 1). The selection of and access to high quality resources for student learning can directly affect pedagogy, and decisions about resources, physical, analogue or digital, should be strongly influenced by teachers and students. This study revealed a frustrating disconnect between increased access to technology and networks in secondary classrooms and the actual ability of classroom teachers and students to benefit from and take advantage of this access. From classroom observations, survey and interviews, a clear finding with regard to blocked or throttled access to online resources emerged: Content and internet site filters, network firewalls and choked Internet speeds prevent students and teachers from accessing high quality online resources during class time. Further, filters and firewalls disrupt and often disable attempts to foster online collaboration. This emphasizes the disconnect that can occur between teachers' expectation and desire for open

access to online resources and administration's view on what is required for teaching and learning in 21st century classrooms.

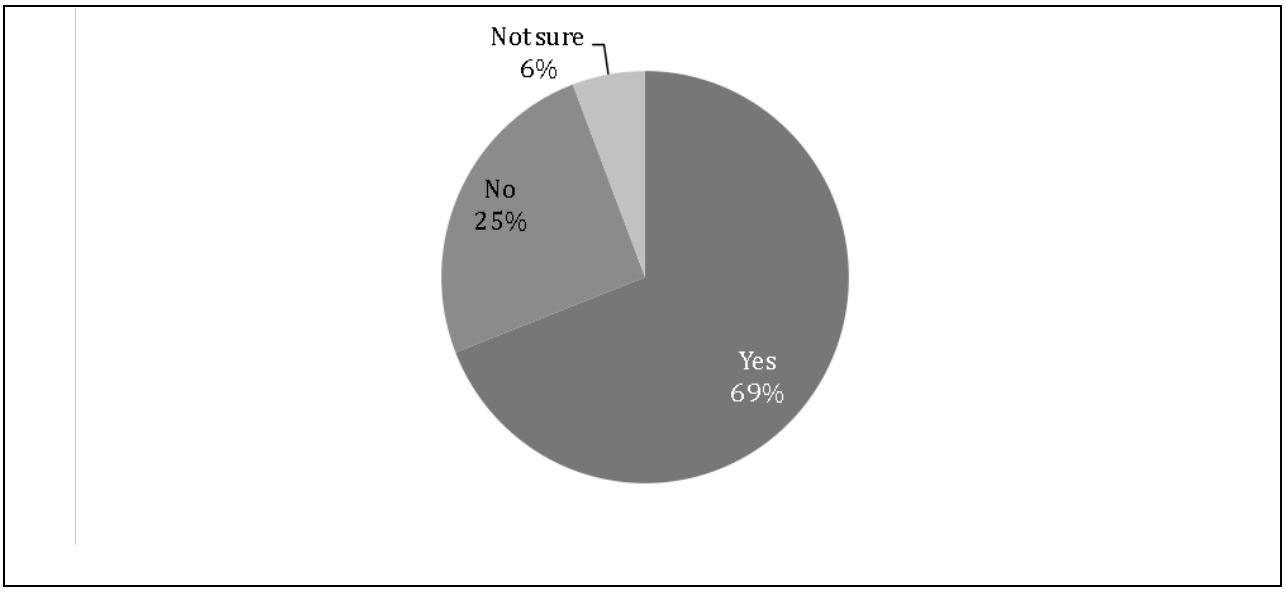

Figure 3. *Teachers (n=294) were asked to indicate whether they have had access difficulty due to firewalls or blocking. The majority of teachers indicated that they had experienced access difficulty.*

Table 1: ***Teachers' Comments Regarding the Types of Access Difficulties***

Comment category	Number of comments	Exemplary comment(s)
Blocked websites	89	Almost all useful sites are blocked, especially for the kids. It should be the teachers responsibility to monitor sites, they should not be firewalled (except for major no no's like pornography).
YouTube related	28	Some videos on You-tube which are curriculum relevant have been blocked due to restrictions even though I have reviewed them at home and they do not breach any access guidelines.
Technical difficulties	26	Can't open my school email or open the server.
Access	19	Because they set firewalls at the school are set by tech people outside of the teaching profession it seems as though the filters are really weird. Sometimes I can't access simple images or websites that I might find useful for teaching or ones that I found at home and yet can't access here.
Student content sites	3	Unable to access student content.
Other	17	The filter at times is very cumbersome.

Conclusion

This initiative provided to us a wealth of data to inform future initiatives that investigate the links between technology, student engagement and school success. For example, what lessons can be learned to increase the transferability and sustainability of technology-supported innovations in schools in the future? What do school districts and schools say they need to sustain and transfer policy innovations?

Unless the processes around technology initiatives change, it is unlikely that the desired sustainability will occur. In this study, consideration of sustainability often occurred towards the end of the initiative once the money had all been spent. Leaving consideration of sustainability to the end of an initiative will be a significant challenge since all the stakeholders must take responsibility and ownership in this process. There also needs to be a realistic understanding of what the technology can and cannot offer (Selwyn, 2010). When technological innovations fail to create systemic change, the easiest solution often seems to be to lay the blame on the technology, to claim that the technology used was inadequate to the task, hoping new technologies might solve the problem thereby relieving others from taking responsibility. However, as Weston and Bain (2010) claim, "…like so many problems in changing venerable institutions, it too often is easier simply to protect the status quo and blame the innovations or the innovator" (p. 9). It is not the technology, per-se, that is or is not having an impact on student engagement, but rather the teaching and learning practices that are enacted and supported to leverage the benefits of technology in new learning designs. While we believe that having technology in the classroom can provide many opportunities for enriched learning, having technology in the classroom is not, by itself, going to cause students to be more engaged in their own learning any more than having a garden is likely to make one a gourmet chef. What we had hoped to document in this initiative was convincing evidence that greater access to classroom technologies enabled teachers to make meaningful changes to how they designed and enacted learning opportunities in their classrooms. While we documented pockets of such innovation in several classrooms, the impact of the Technology and High School Success initiative was not widespread, did not result in systemic changes in vision or strategy, and has not resulted in sustainable changes to learning opportunities for Alberta students.

As researchers who have worked on a number of these initiatives, it is striking to us the similarity of these projects in terms of goals and outcomes, despite the attempts by the provincial ministry to try to improve the chances of success. Through this study we have been able to examine 3 barriers that make it difficult to create systemic change: 1) schools and school districts did not leverage the opportunity to revisit their existing vision(s), 2) schools and school districts did not use collected data to make changes, and 3) limited effective access to technology. Though perhaps not exhaustive, addressing these barriers is a necessary step in ensuring that technological initiatives are systemic, effective, and sustainable.

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