

## The Use of Technology in Facilitating Student Teachers' Lesson Planning Process and Improving Their Quality of Classroom Life

Virginia Fraser [vaf2t@virginia.edu](mailto:vaf2t@virginia.edu)  
University of Virginia

Joe Garofalo [jg2e@virginia.edu](mailto:jg2e@virginia.edu)  
University of Virginia

Nicole Juersivich [nrm3w@virginia.edu](mailto:nrm3w@virginia.edu)  
University of Virginia

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One of the primary functions of educators is classroom instruction. Quality instruction begins with a well-designed plan for implementation. Teachers, through conscious, deliberate decisions involving teaching methodologies and their knowledge of students, shape the scope and sequence of instructional content, the characteristics of teacher-student interactions, and the nature of the students' personal and cognitive growth (Panasuk & Sullivan, 1998). Teachers therefore exert substantial influence on student learning as they align the educational content, focus, and strategies to utilize in the classroom (Little, 2003).

Besides planning for instruction, teachers perform many additional jobs. These include clerical, administrative, janitorial, and standardized testing tasks. Thus, teachers work an average 52 hours a week and the need to complete this work is now encroaching on their home and family time (Allen, 2007; Wolf, 2002). As Turley (2006) comments, "Essentially, there is more work to do, but available time remains unchanged" (p. 438). Consequently, teachers are reporting that these ever-increasing functions curtail the time they have to develop intricate lessons that enhance student understanding and achievement (Allen, 2007; Certo & Fox, 2002;

Firestone & Bader, 1991).

Paradoxically, educational reformers are simultaneously urging teachers to devote more of their attention to thoughtful lesson planning focused on the incorporation of conceptual knowledge (Panasuk & Todd, 2005; NCTM 2000). Studies, such as the Third International Mathematics and Science Study, indicate that the planning for, and practice of, teaching mathematics in too many classrooms do not sufficiently address conceptual and contextual aspects (Hiebert et al, 2003; Stigler & Hiebert, 1999). Typical lessons consist of homework review, followed by sample exercises, and then individual practice tasks (Little, 2003; Panasuk & Todd, 2005). This format overemphasizes procedures and does not encourage conceptual understanding. Thus, to address this imbalance, mathematics teaching needs to incorporate a logical arrangement of concepts, involving realistic situations, in which meaningful connections are drawn between ideas (NCTM, 2000; Panasuk, Stone, & Todd, 2002). The use of technology can promote this deeper understanding, since it can empower students to discover, explore, and conjecture about mathematical ideas; that is, it allows students to act and think as mathematicians by fostering their conceptual understanding (Borwein & Bailey, 2003; Heid, 1997).

#### *Use of technology for managing teacher tasks*

Moreover, we have found as Thomas, Larson, Clift, & Levin (1996) assert, “student teachers are more apt to embrace, model, use, and incorporate technology into their instructional planning and classroom organization.” (p. 7). However, PSMTs experience problems with managing student needs and discipline, formulating lesson presentation and evaluation, relating with students and other teachers, and regulating time (McCann & Johannessen, 2004). Furthermore, these novice teachers suffer anxiety due to cognitive overload when trying to

control excessive stimuli that short term or working memory cannot handle (Feldon, 2007). Fortunately, as Taylor (2004) claims, “current advances in technology offer welcome relief from laborious tasks that decrease the amount of time teachers have to focus on instruction” (p. 46). Hence, the use of technology can lighten the burden of classroom duties and enhance teacher quality of life.

### *Preparing teachers to use technology*

Our primary goal in preparing PSMTs to use technology is for them to take advantage of the affordances of technology to enhance their students’ learning of mathematics in ways that are not possible without the technology. Our PSMTs complete a five-year program, which includes student teaching in the fall of their fifth year. Before student teaching, all PSMTs spend two semesters in a technology-rich mathematics pedagogy course, which focuses on problem solving, conceptual and procedural knowledge, constructivism, mathematical applications, and the NCTM (2000) *Principles and Standards*. The course integrates a variety of technologies in meaningful mathematical activities and emphasizes using technology to generate multiple representations (Garofalo et al, 2000). They use these technologies with a SMART Board and SMART Notebook in course mini-lessons and in field experiences in local high schools (sometimes without a SMART Board). We provide feedback on pedagogy and technology use following each lesson.

### Purpose

In this paper, we report on (1) how pre-service secondary mathematics teachers (PSMTs), who had experiences doing and practice-teaching mathematics in a technology-rich environment, subsequently used this technology when planning lessons and (2) how the use of technology affected other aspects of the PSMTs’ quality of classroom life. These results emerged in the

process of studying how the PSMTs' integrated technology into their student teaching and their rationales for doing so.

## Methodology

### *Participants*

Two cohorts of PSMTs participated in this study. The first cohort consisted of 10 PSMTs, who student taught in fall 2005. The second cohort consisted of six PSMTs, who student taught in fall 2006.

### *Student Teaching*

Researchers have recognized that simply using technology to learn mathematics will not guarantee that teachers will use it in their teaching, for many factors confound the initiative to use it (Olive & Leatham, 2000). To enable our PSMTs to implement the technologies they learned, we provided them with a laptop, a SMART Board, a projector, and software to use during their student teaching. PSMTs were observed and debriefed regularly and met weekly as a group to discuss teaching and technology issues. Furthermore, during these seminars, PSMTs shared their technology files and explained how they used them in their classrooms.

### *Data Collection*

Consistent with the purposes of this study, the data collection was both descriptive and qualitative. Data were collected through various means such as *observations*, *interviews*, and *artifacts*.

*Observations and debriefings.* During student teaching, we observed at least five, 90 minute, teaching episodes per PSMT. Observers took notes focusing on student engagement, meaningful learning, technology use, lesson context, behavior/classroom management, rapport, and the accuracy of the mathematical content. Following the observation, a debriefing session

was held. The PSMTs commented on classroom situations that worked or needed improvement, their planning processes, and their rationales about how and when to use technology. These debriefings were audio recorded and transcribed.

*Interviews.* Prior to teaching in their student teacher placements, we interviewed the PSMTs concerning their views on planning, what constituted effective mathematics lessons, potential teaching and learning benefits of technology, and their primary motives for using technology. After student teaching, we asked similar questions and had the PSMTs provide examples from their placements. These interviews were audio recorded and transcribed.

*Reflective journal.* During their student teaching placements, the PSMTs kept an electronic technology reflective journal in which they wrote weekly about any feelings, thoughts, or issues they had with the technology in their field placement. They posted the journal entries to a secure website.

*Teaching artifacts.* PSMTs saved their technology files and lesson plans on a common share-drive to which all had access. Later in the semester during the group seminar, PSMTs demonstrated their best lessons and technology files and gave a synopsis of how they incorporated technology into their lesson.

### *Data Analysis*

We adopted Erickson's analytic induction (1986) to analyze the data. In the first phase of data analysis, we generated assertions by carefully searching through the data corpus. The second phase established an evidentiary warrant for each assertion by performing "a systematic search of the entire data corpus, looking for disconfirming and confirming evidence, keeping in mind the need to reframe the assertions as the analysis proceeds" (p. 146).

We imported the typed reflective journals and transcribed interviews into *NVivo7*. The team then open-coded discrete chunks of information using descriptive, conceptual, and in vivo codes. The software gave us the opportunity to apply multiple codes to the same selection of information. After open coding, we noticed the emergence of two main codes: *Representation* and *Quality of Life*. This paper focuses solely on the latter, *Quality of Life*.

Under *Quality of Life*, two main themes emerged through readings and re-readings of the information within node and sub nodes of *Quality of Life* across and among participants. By using *NVivo7*'s query attributes, these themes were revised and eventually became four assertions. Systematically searching for confirming and disconfirming evidence, assisted by analytic memo-ing authenticated these assertions.

## Results

We summarize our findings through the following four assertions.

*Assertion 1: The provided technology encouraged PSMTs to prepare comprehensive lesson plans, organized through a storyboarding process, by easily permitting the incorporation of a variety of resources into one file or one folder.*

When asked how technology aided their planning, all of the PSMTs stated revelations, similar to that given by K1, “well it’s an easy way to plan and this is a convenient way to organize a lesson.” (K1 Exit Interview). Their responses and teaching artifacts indicated they employed PowerPoint and SMART Notebook programs for the storyboarding of lessons during the planning stage. This entailed the creation and organization of various slides that contained examples, figures, digital images, definitions, graphs, videos, and interactive files, sequenced for a particular concept. These slides represented their plan of instruction. C2 noted this practice in her reflective journal:

The SMART Board and the SMART Notebook are great tools for organizing a lesson and laying out a lesson prior to teaching...When I am planning lessons, I use the SMART Board to help organize my lesson and order it appropriately. (C2 Reflective Journal)

Storyboarded lessons incorporated information in several ways. The PSMTs inserted images, diagrams, and text excerpts into their files by copying and pasting them into the corresponding slide. L2 conveyed this approach in an Algebra 2 class, “I got a digital camera for my birthday and used some digital photographs of roofs to illustrate the concept of slope and steepness of slope. That worked well because it was something the students could relate to.” (L2 Reflective Journal). Another PSMT, K1, copied and pasted selections from an online geometry textbook, into his lessons file (see Figure 1).

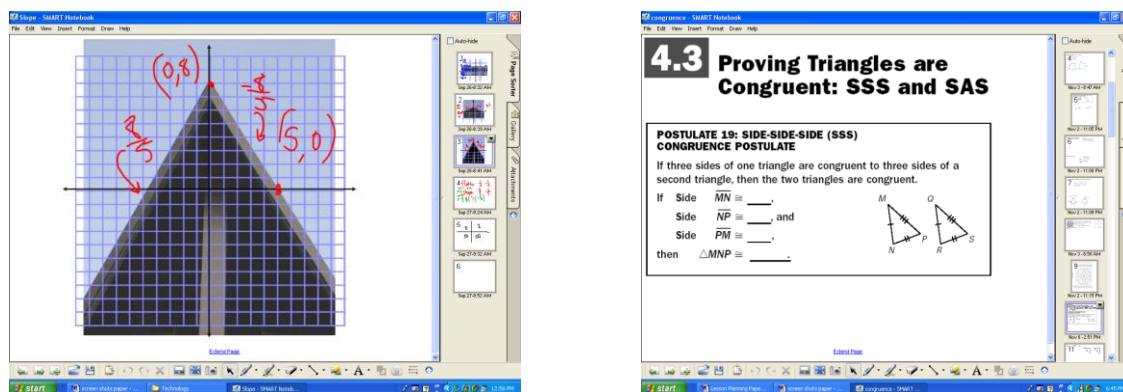
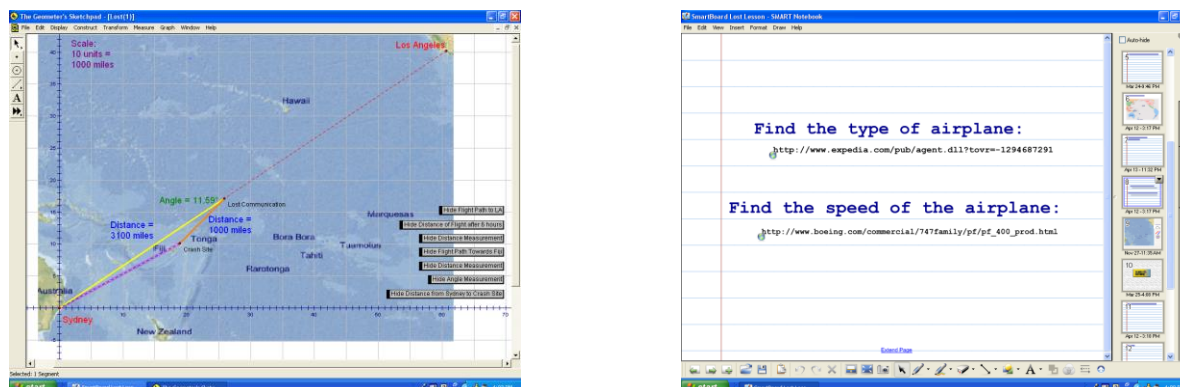


Figure 1: Examples of copying and pasting to SMART Notebook

Links to various sources were also used in the SMART Notebook file or PowerPoint file. The PSMTs could then tap on the link and the corresponding screen appeared. A2’s lesson, involving the mathematical concepts of the law of sines and cosines, exhibited such use. A2 inserted a clip of the TV show “Lost” into the SMART Notebook. The show centers on survivors of a downed plane which left Sydney, Australia and was headed for Los Angeles.

In the video, the pilot detailed the problems with the flight of the downed plane. The pupils’ job was to locate the survivors of the crash by constructing their irregular flight pattern using the information presented in the clip. The PSMT placed a link to a Geometer’s Sketchpad

file that contained a map of the situation (Figure 2). The pupils then used this information and previously learned trigonometry to determine the location of the survivors. The PSMT further included internet links that provided realistic data on the plane type and speed used in this travel to determine the location of the crew (Figure 2).



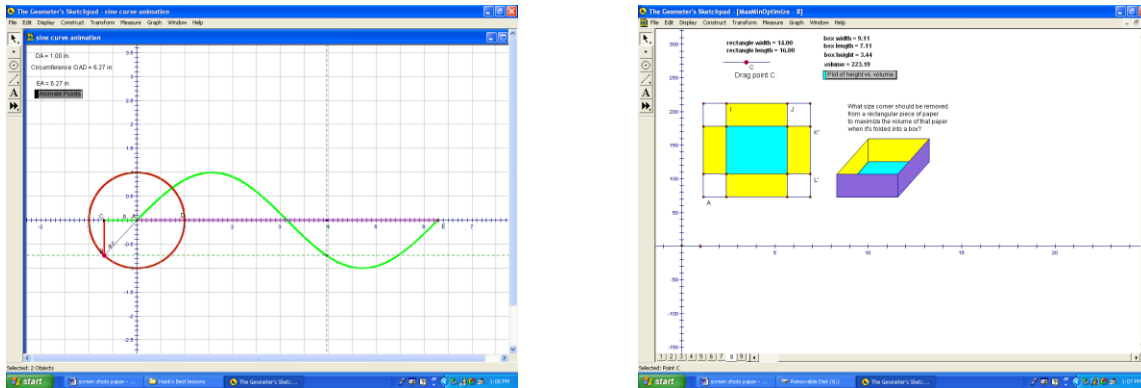
**Figure 2: Geometer's Sketchpad map and airplane links**

Including these resources into her Smart Notebook file allowed A2 to access information easily.

The PSMTs also accessed files and web pages or other technology sources by opening and minimizing them and then tapping the SMART Board on their tabs when needed. E11 explained this use in her exit interview:

I love the idea of having everything at your fingertips. So then if I know that I want to switch from Notebook, where I have notes for them and switch to a worksheet that they're working on and switch to a website I want to show them and then go over to Excel to do something, that I know that could do all that (E11 Exit Interview).

Two examples of how PSMTs accessed other programs through tapping on tabs are H1's use of a *Geometer's Sketchpad* animation demonstrating the relationship between the unit circle and the sine wave and C2's use of an interactive *Calculus in Motion* file demonstrated optimization of the volume of a box (see Figure 3).



**Figure 3: Geometer's Sketchpad and Calculus in Motion files**

While the PSMTs acknowledged the benefits of lesson planning with technology, they also recognized the extra time that using technology in planning initially required. They noted however that this time lessened as the semester progressed. C2 explained:

Ah well it took less time as we went on or I just spent less time on it. I think it gets easier the more you do it and you figure out how detailed the presentation has to be,... like how much manipulation you want to have, how much clicking, and dragging. It gets a lot easier so it doesn't take as long (C2 Exit Interview).

Even with this learning curve, most however professed they thought it is worth the effort.

*Assertion 2: The storyboarded lesson files, used in conjunction with SMART Boards, helped PSMTs maintain their lesson plan focus, often reducing their anxiety.*

One particular concern for the PSMTs was their ability to function effectively in front of students. Like many other beginning teachers, these PSMTs considered the enactment of planned instructional activities while simultaneously managing classroom environments a challenge. They viewed technology as an important tool for coping with these issues. The PSMTs asserted the software programs, projected on the SMART Board, helped them to remember what they had planned to teach, in what sequence. As C2 stated, “organizing my lesson using SMART Notebook helps keep me on task, and teaching the lesson the way I planned it.” (C2 Reflective Journal).

The PSMTs used the storyboarded lesson files to guide the course of their lesson and it allowed them to refocus their attention if they got off track. As A2 acknowledged, “I prepared PowerPoint slides or Notebook slides to help guide the direction of my instruction, which proved helpful when we got sidetracked” (A2 Reflective Journal). They did not need to fret about keeping track of their lesson sequence because it was always “at their fingertips” by means of thumbnail slides. As K1 remarked:

But using the technology I could just plan my lesson out with technology and I would have it there so I wouldn't have to write anything out on the board and I wouldn't have to kind of worry which example I was supposed to be doing with them (K1 Exit interview).

If they were sidetracked or lost their flow during instruction, they could refocus their teaching by tapping on the next thumbnail at any time.

The PSMTs recounted that they found many aspects of instructional delivery daunting and tricky to manage. The PSMTs confided the use of this technology helped soothe their apprehensions. C2 reported:

With so many distractions, anything that can help organize a lesson so that it runs like a well-oiled machine once it begins is essential in calming a nervous new teachers' nerves when teaching (C2 Reflective Journal).

When their lesson was planned, using the SMART Board, they felt supported. This helped them to relax so their lessons delivery was much smoother.

The technology also helped teachers maintain focus by alleviating classroom management concerns. Some felt the SMART Board allowed them to be in front of the class, which afforded them better access to the content on the screen. The PSMTs also referred to classroom management issues such as freedom to move about the classroom and facing students to observe their behaviors. E11 states, “In the 7<sup>th</sup> grade, I used the SMART Board for Jeopardy-

again it was nice to be able to stand in front of the classroom and control the computer so that I could keep an eye on all the students” (E11 Reflective Journal).

*Assertion 3: The digital lesson files, implemented with SMART Boards, promoted sequencing flexibility in PSMTs’ teaching.*

The PSMTs reported that the SMART technology allowed them to go back or move ahead to a slide at any moment in the lesson as was needed. A2 explained this capacity:

I definitely ran into situations where we would be going through a problem and they’re like, “Wait, I don’t understand why we did that.” It would be really easy to go back and see we did the same thing here and this was why. Or if they were flying through something, I would be able to move faster or skip extra problems that I had inserted there (A2 Exit Interview).

If the students required checks in understanding, she was able to go back and re-address concepts. However, if the students were showing comprehension, she could move forward and skip some pre-planned material by just advancing to the next slide in the presentation. This process allowed her to adjust her instruction to accommodate student questions and needs. D2 similarly commented:

I like how everything can be saved on Notebook, so I am not erasing things I wrote on the board previously. A calculus student had a question about something we talked about earlier in the class and luckily I could just go back to the slide and look at what I had written down. I am sure if I was using a chalkboard that I would have erased those notes. (D2 Exit Interview)

The SMART Board technologies also provided the capacity to change the intended pacing of the pre-planned lesson. A2 recalled one such situation:

I was teaching quadratics, quadratic functions and they weren’t proficient with graphing parabolas. I inserted more examples on that and showing the graph and table on the same screen, at the same time to show them, to have them get more practice with that. (A2 Exit Interview)

She detected the students were having difficulties with a topic and she added examples on the SMART Board by hitting the extend page command at the bottom of an existing page. She also inserted a new tile, which provided a blank page on which to write additional material.

*Assertion 4: Due to their digital nature, the readily accessible lesson files and folders created by the PSMTs fostered the reusing and sharing of complete lessons.*

The PSMT's realized they could reuse the developed materials. Since some of the PSMTs taught more than one section of a course, they contended having the electronic access and the ability to reuse the same prepared materials in every class was most advantageous. M1 talked about her use of the calculator in these multiple classes. She was solving 3-variable systems in her Algebra 2 classes using matrices and Cramer's Rule. She performed the steps on the calculator and saved these in a file (see Figure 4) that was reused in each class. She explained, "The big thing was not having to go through and enter all of the numbers over and over again. With three sections of the same class, I really enjoyed the liberty of having everything preset" (M1 Reflective Journal).

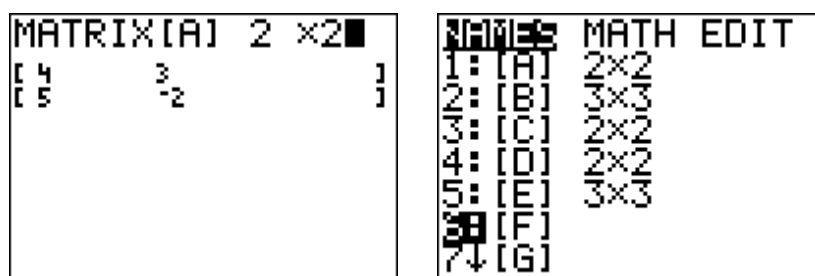


Figure 4. M1 Calculator preset matrices file

A variety of factors contributed to daily fluctuations in the PSMTs' ability to complete the intended material within an instructional period. Lesson plans were not stagnant and therefore had to be altered to accommodate these situations. The technology aided in this process. D2 stated:

Just organizing your own lesson and having the kinds of slides to show where

you want to go and if you fall short one day, you can just copy the slides that you didn't cover and put it in a new, you know, notebook file (D2 Exit Interview)

She noted that information from one file could be easily transported into another lesson file, which maintained the fluidity of planning despite the unscheduled disruptions.

The PSMTs commented their lesson files can be reused in subsequent teaching, either as is or with revision. Technology was viewed by the PSMTs as an integral component in this modification. C2 wrote:

Because the lesson is digital, re-ordering or correcting aspects of the lesson is easy and not very time consuming. The ease of putting comments in the lesson for future reference is also an advantage. A second advantage is being able to easily update and adjust lessons accordingly to how students responded and to annotate for other teachers to use. Adding slides, as well as reordering slides to accommodate different classes is quick and efficient. All of these advantages deal with the edit-ability of digital media (C2 Reflective Journal).

K1 further noted that previously developed electronic material was easier to locate for future reuse. K1 noted, "If the subject is taught again, the files will not be stuffed away in the back of a file cabinet. They will be stored digitally, ready for action" (K1 Reflective Journal).

The PSMTs thus found that the electronic files were less bulky and more accessible for the teacher to share with others. A2 remarked, "I like having it always accessible. It's not on a piece of paper where or I have to make a transparency of it. I can use it in different computers. So that makes my life easier" (A2 Exit Interview). As she moved from room to room, her materials were always with her for she could locate them on any networked computer in the school. L2 discovered that he could use this network capability to make his pre-made files available to his pupils. He explained, "To do this activity I had to put my file onto the student's shared server, which proved to be fairly easy after first encountering some difficulty. I simply created my own unrestricted folder and that solved the problem" (L2 Reflexive Journal). Thus, they could easily locate the needed files on their classroom set of laptops and complete the lesson

activity. The PSMTs additionally shared their created lessons with each other. H1 commented on this in his final interview:

One thing I like about it (technology) was that it could easily do collaborative sort of planning. I mean one of things I liked about it because of the electronic file of notes on the board, if somebody got really great stuff you know your not reinventing the wheel...It saves tons of time and again it sort of like teachers that have collaboration of different teachers on a particular subject, that's helpful. (H1 Exit Interview)

The PSMTs used their digital storyboarded lesson files when catching up pupils on the material missed due to absenteeism. They made comments such as

If students are absent you have a copy of everything that you wrote and so instead of drafting a lesson on pen and paper, I can draft the lesson on my computer and then make changes, which just eliminates the whole need for writing it down on paper (D2 Exit Interview).

Um it makes it easy to save your lesson so you can print it for the kids who weren't there. Which was really helpful. Especially in algebra because at any given day you have about 6 kids absent. So it made it easy to catch them up or at least give them the material for them to try to catch up (C2 Exit Interview).

If a kid's not there I can have the SMART Notebook file or the PowerPoint file and if they want to come during lunch and just have that to go through on a laptop or whatever instead of having them try to do bookwork on their own. It's a nice way to catch, keep students caught up (A2 Exit Interview).

## Discussion

The PSMTs found the capabilities of the technology allowed them to develop a comprehensive lesson plan employing multiple resources. They arranged their ideas through storyboarding individual slides, which constituted an outline of their lesson. The PSMTs found that that having a pre-planned storyboarded lesson along with viewable thumbnails of the lesson slides on the SMART Board aided them in staying focused on their plan or redirected their attention back to the plan if they were sidetracked and contributed to the reduction in experienced anxiety for many of the PSMTs. It is important to note that the PSMTs used the

software for storyboarding almost spontaneously, without any prompting from us. They watched us use technology in the secondary pedagogy course but without storyboarded lessons. However, when teaching mini-lessons in the course, they all independently brought in their prepared lessons on a thumb drive. On their own, they recognized the advantages of using these pre-planned storyboarded lessons.

The PSMTs made use of the technology's facilities to perform desired adjustments to their pre-planned script in order to clarify student misunderstanding. During instruction, they toggled back to previous material or moved ahead to other examples to facilitate student conceptual understanding. They also modified their intended examples by adding more or different problems and by deleting unnecessary work, further illustrating the concepts. This allowed them to evaluate constantly the effectiveness of their lessons.

The PSMTs found that since their lessons were electronically generated, changes to these files were easily executed. This eliminated the necessity for re-creating content information and allowed the PSMTs to reuse these lesson plans in multiple sections of teaching and be available to them for present and future use. Technology also made the accessibility and thus sharing of created files with students and other colleagues possible.

This study illustrated how technology facilitated mathematics PSMTs' quality of life by aiding in the lesson planning and reducing the stresses of instructional duties and responsibilities. However since it was bound in context, the conclusions do not easily generalize to all student teachers without further study. This study was additionally limited to a technology-rich, five-year teacher education program. It is not known, therefore, if the findings would convey to other teacher education programs. Nevertheless, these results could aid other educators to realize the advantageous capabilities of technology for use in teacher planning.

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