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Instructional Technologies and Pre-Service Mathematics Teachers' Selection of Technology

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Abstract
There are many available technologies that can assist future teachers to deliver instruction. The purpose of this paper is to provide a brief review of literature identifying available technology tools in mathematics education and which technologies are selected by PSTs to design mathematics lesson activities. The most commonly used and available technology tools in mathematics education and the technological tools most frequently selected by PSTs are described, based on an analysis of 68 lesson activities. The result shows that PSTs selected technology activities based on an assigned topic and grade level.
Keywords: Technology, Mathematics Education, Lesson Activities, Pre-service Teachers

1. Introduction

Over time, education has been influenced by the rapid development of technology. Education should prepare students to use mathematics in the technology-based world. Teachers and school systems have a responsibility to prepare students for real life and help them to know how to use technology when they face problems in the real world (Heddens & Speer, 2006).

Two hundred years ago, technological improvements began and teachers started to use an abacus as a technology in teaching and learning. The first hand-held calculators were presented in 1972 (Waits & Demana, 2000), the first microcomputers for school use were promoted around 25 years ago, the first graphing calculator was marketed almost 20 years ago, and we started to use the internet (i.e., World Wide Web) almost 15 years ago (Heid, 2005). There is obviously increased technology use in mathematics education from 1968 to 2009 (Ronau et al., 2014). However, current research indicates that instructional technology integration is not high in K–12 mathematics classrooms, especially in high schools. The use of technology decreases from elementary school to high school: 33% in the elementary math classroom, 28% in the middle school mathematics classroom, and 21% in high school mathematics classroom (Banilower, Smith, Weiss, Malzahn, Campbell, & Weis, 2013).

A variety of technological tools are available for teachers and pre-service teachers (PSTs) to integrate into mathematics instruction, such as virtual manipulatives, educational software, Interactive White Board, Graphic Calculators, the Internet, and the like. Calculators and computers are potential tools to enhance students' understanding and learning of mathematics (Heddens & Speer, 2006). Powers and Blubaugh (2005) highlighted that the use of technology such as computer technologies and graphic calculators by PSTs into their future teaching is one of the ways to adapt mathematics education into the technology era. However, some PSTs and even in-service teachers do not know how to implement technological tools or which technological tools are available for teaching. As Gorder (2008) stated, many teachers do not feel comfortable integrating technology into the classroom environment. Ahmad and colleagues (2010) expressed that the integration of technological tools can offer variety for students' learning in the technological age. However, Wachira and Keengwe (2011) found that while computers with Internet, textbook publishers' tutorial sites and CD-ROMs, and calculators are commonly available technologies in schools, technology integration remains limited.

For example, Ronau, Rakes, Bush, Driskell, Niess,and Pugalee (2014) examined 480 dissertations from 1968-2009 in which technology has been studied, and they found that 703 technology types have been addressed in these dissertations. Computer software (n=268) is the most studied technology, and Internet technologies (n=112) are the least addressed technology in these dissertations. Besides, calculators are addressed 175 times, and other technologies (such as an Interactive whiteboard, email, Probeware, computer programming, etc.) are mentioned 148 times. Furthermore, Polly (2014) observed three teachers and found that teachers rarely used the desktop computer or iPad computer; however, teachers used the document camera and projector in every lesson to demonstrate mathematical tasks and students' work. In the next section, available technological tools for mathematics instruction are explained in further detail. These tools are most commonly used and available technologies in mathematics teaching and learning environment.

2. Available Technology Tools in Mathematics Education

Technology use is one of the ways to provide effective instruction for students (Unluol-Unal & Akcay, 2015), and we should prepare our future teachers for which technologies are available for them to use in their future classroom. The purpose of this section is to conduct a literature review which focuses on available technology tools in mathematics education.

2.1 Calculators

The calculator is most commonly used and basic tool in mathematics education. There are two main forms of calculators: scientific and graphing calculators. Use of graphing and/or scientific calculators are infrequently observed at the elementary school level, in contrast to most frequently at the high school level (Banilower et al., 2013).

The National Council of Teachers of Mathematics (NCTM) highlights the importance of integrating calculators into instruction and recommends that schools and teachers make calculators available for all students from kindergarten to college level. Researchers suggest that to support students' learning in mathematics, the calculator is not used to replace students' thinking or students' ability to perform basic procedures (Pomerantz, 2009; NCTM, 2005; McCauliff, 2004).Instead, as suggested by Heddens and Speer (2006), incorporating calculators into instruction could be effective in mathematics programs at all grade levels because the use of calculators can help students access rich problem-solving experiences and can positively affect the learning and teaching of mathematics. Pencil and paper can limit students' engagement with some mathematics concepts and real-world contexts (e.g., due to tedious calculations or messy numbers); however, the use of calculators allows students to access and explore these concepts by generating multiple examples, enabling the exploration of patterns, or in the case of graphing calculators, easily portraying multiple representations (Pomerantz, 2009).

Instructors should consider the use of calculators as an integral teaching and learning tool (Heddens & Speer, 2006) because calculators allow students to reach higher-order-thinking (Pomerantz, 2009; NCTM, 2011). Besides, "when students are engaged in solving problems, formulating and applying strategies, and reflecting on results, a calculator is an important enabling tool" (Reys & Arbaugh, 2005, p. 93). Developing students' ability to use calculators is important, and the role of the instructor is to help students to understand how and when to use a calculator (Heddens & Speer, 2006). The skill, knowledge, and ability of classroom teachers shape and affect the use of calculators. For example, "in the classroom of a thoughtful and talented teacher, the calculator can be especially useful in developing understanding of place value, reversibility, relationships among numbers, operations, decimals, metric measure, prime factoring, composites, changing fractions to decimals, and percentages, as well as making mathematical estimates" (Heddens & Speer, 2006, p. 60).

Calculators should be integrated into instruction in order to enhance student understanding of mathematical concepts (Heddens & Speer, 2006); however, some researchers argue that instruction with calculators in elementary school poses a threat for students, so teachers should not use a calculator until students master the basic facts. Niess (2006) indicated that there is still a challenge for mathematics teachers to examine using calculators as tools for students' thinking rather than as tools to replace their thinking. Teachers need the ability to make choices about using calculators in ways that support students' thinking rather than to replace students' development of mathematical knowledge and understanding.

2.2 Computers

Computer and the Internet are more commonly used sources for teachers in the teaching and learning environment. Teachers can access teaching materials, teaching ideas, lesson plans, and activities through searching on the Internet. In today's classrooms, the computer can be connected to the Internet, and interconnected with the interactive whiteboard, projectors, and/or printers to share information with students.

Smerdon, Cronen, Lanahan, Anderson, Iannotti, and Angeles (2000) reported that almost all (99%) public schools had computers available somewhere in the schools. In 2009, 97% of teachers had at least one computer located in their classroom, and 93% of these computers had available Internet access in public schools (U.S. Department of Education: National Center for Educational Statistics, 2010). Also, the Internet is used on a weekly basis in 43% of elementary mathematics classes, 26% of middle-level mathematics classes, and 11% of high school level math classes (Banilower et al., 2013).

Over the last ten years, computer availability has increased in the classroom. However, some teachers do not have enough experience to integrate computers in the classroom, and some teachers do not allocate time to prepare lesson plans and teach mathematics using computers (Heddens & Speer, 2006). Ke (2008) studied the effect of computer games, and concluded that use of computer games increases students' attitudes positively toward mathematics; however, it does not affect students' cognitive mathematical achievement.

2.3 Interactive White Board

The Interactive White Board (IWB) has become as popular over the last few years as other technologies. IWB is also referred to as SmartBoard or White Board. IWB is a large and touch-sensitive device (Smith, Higgins, Wall, & Miller, 2005) that connects to a computer and a multimedia projector through installed software. Swan, Schenker, and Kratcoski (2008) explained IWBs as:

> "Virtually anything that can be done on a computer can be done on an interactive white board, with the advantage that interaction involves fingers and pens and so is more kinesthetic, drawing, marking and highlighting of any computer-based output is supported, a whole class can follow interactions, and

lessons can be saved and replayed". (p. 3290).

IWB has flexibility and efficiency features to support teaching and learning; however, the U.S Department of Education (2010) stated that only around 25% of teachers in the USA had access to interactive whiteboards as needed for everyday uses. Lai (2010) indicated that practice in using IWB helps teachers to integrate IWB in a meaningful way into instruction. Student learning, motivation, and achievement can be affected by the use of IWB, but these effects are related to teachers' confidence, training, practice time, and technical support in using the IWB (Digregorio & Sobel-Lojeski, 2009).

2.4 Instructional Software and Web-Based Resources

There are several types of instructional software programs available for teachers to use in their classrooms. Various types of software are categorized as exploration tools, simulations, educational games, drill, and practice, problem-solving, and tutorials (Heddens & Speer, 2006), and teachers should be critical to use them. Some examples of instructional software and web-based resources are GeoGebra, IXL, Khan Academy, National Library of Virtual Manipulatives (NLVM), and NCTM Illuminations, which are discussed below.

GeoGebra. GeoGebra is dynamic geometry software including geometry, algebra and calculus features and is an open source tool for teaching and learning mathematics (Hohenwarter, Hohenwarter, Kreis, & Lavicza, 2008) from middle school to higher education. Hohenwarter and Fuchs (2004) described uses of GeoGebra for demonstration and visualization, discovering mathematics, and preparing teaching materials.

IXL. IXL is an example of a drill and practice site for kids preschool through high school and can provide independent practice. IXL offers over 2,000 math-practice modules, and almost all these practices meet Common Core mathematics standards (IXL website)**.**

Khan Academy. Khan Academy is a free tutorial site for anyone anywhere. The site offers practice exercises, instructional videos, and personalized learning experience to engage students for all ages. Khan Academy has over 5,500 instructional videos, and mathematics is the richest content area (3,500 of which teach math concepts) (Khan Academy Website).

Virtual Manipulatives. Use of virtual manipulative can help students to visualize relationships (Heddens & Speer, 2006). Moyer, Bolyard, and Spikell (2002) described a virtual manipulative as "an interactive, web-based visual representation of a dynamic object that presents opportunities for constructing mathematical knowledge" (p.373). Virtual manipulatives allow students to understand mental (abstract) ideas and symbols, and demonstrate these abstract ideas in more meaningful ways to students (Durmus & Karakirik, 2006).

National Library of Virtual Manipulatives (NLVM) and the *National Council of Teachers of Mathematics (NCTM) Illuminations* are popular web-based virtual manipulatives tools. NVLM is a supported project by the National Science Foundation to produce interactive virtual manipulates (NVLM, 2015; Durmus & Karakirik, 2006), and is a digital library containing Java applets and activities for K-12 mathematics (NVLM, 2015).

NCTM Illuminations allows students and teachers to access quality standards-based resources (lesson plans, activities, and games), including interactive tools to support teaching and learning mathematics (see the Illuminations.NCTM.org website). NCTM Illuminations provides students and teachers electronic sources to improve mathematics learning and teaching (Keller, Hart, & Martin, 2001). All interactives and lessons are categorized based on grade levels and the NCTM Content Standards and Common Core Mathematics Standards. Hart, Keller, Martin, Midgett, and Gorski (2005) described features of NCTM Illuminations as:

- Online, interactive, multimedia resources (primarily using applets and videos)
- Internet-based lesson plans
- Reviewed and categorized external Web resources
- A Web design framework that organizes and presents the content in such a way that the design itself helps illuminate Principles and Standards and makes all content as usable and accessible as possible (p.222).

Wiki and Blogs. Wiki and Blogs can be used in mathematics teaching. According to Krebs, Ludwig, and Muller (2010) wiki is one of the essential tools to communicate and cooperate with others. Also, a blog or a wiki can be used to provide a space for students to record their initial thoughts, questions, and solutions, and posts in the blog are only viewable by the instructor and author of the post. For collaborating works, the wiki can be provided to students to work with their classmates. Primarily technological tools in distance education, wiki and blog are rarely used in mathematics education when compared to other content areas and disciplines.

2.5 Other Technologies

Another technological tool in math education is the Mobile Device (e.g., smartphone, iPod, tablet PCs, handheld gaming devices, and so on), which is a new trend in educational settings. Mobile devices allow students to connect to the digital world while sitting in the classroom (Franklin & Peng, 2008). Baya'a & Daher (2009) highlighted how the use of mobile phones in education could enable student learning of mathematics as students

can explore mathematics independently; help students to learn math through collaboration across physical locations; demonstrate real life situations; help the student to learn mathematics easily and visualize complex mathematical contents.

Multimedia is another tool used in education. Multimedia offers a combination of different content such as audio, text, image, video, animations, etc. Teachers would need to be comfortable with technology and know how to integrate multimedia technology into the learning environment (Heddens & Speer, 2006). Teachers can use multimedia tools as a classroom application, and students can use them as productivity tools (Heddens & Speer, 2006). Ahmad, Yin, Fang, Yen, and How (2010) highlighted that students' understanding is better when teaching with multimedia than traditional methods, because multimedia provides a visual presentation, 3D shapes, and helps students to engage with mathematics easily.

There is the variety of technology tools available for teachers and PSTs to teach mathematics as highlighted above. In the next section, technologies selected by PSTs for lesson activities in an elementary (grades PK-4) program, Middle-Level (grades 4-8) program and Secondary Mathematics (grades 7-12) program are presented.

3. Selection of Technology by Pre-Service Teachers

Teacher educators should be aware of the importance of implementation of technology as a teaching and learning tool and prepare future teachers based on this goal. Powers and Blubaugh (2005) stated that the most problematic issue in teacher preparation programs is the use of technology. Bell (2001) provides a guideline for teacher educators to prepare PSTs to use of technology. This guideline includes "appropriately incorporate technology into their teaching, in regular classrooms equipped with graphing calculators and a computer and in computer labs, to enhance students' conceptual understanding of mathematics and its applications, become savvy using, evaluating, and choosing technologies, (and) modify their curricula and develop materials to capitalize on available technologies".

Some researchers have developed guidelines to direct PSTs to integrate technology successfully. For example, Garofalo, Drier, Harper, Timmerman, and Shockey (2000) identified five guidelines for PST to plan for instruction using technology, one of them is that introduce technology in context. This guideline includes: 1) Introduce technology in context; 2) Address worthwhile mathematics with appropriate pedagogy; 3) Take advantage of technology; 4) Connect mathematics topics; 5) Incorporate multiple representations (p.67).

Technology courses offered in teacher education programs should be connected with methods course (Kay, 2006) because only taking technology course does not show PSTs' ability to successfully integrate technology (Wang, 2002). Teacher educators might encourage PSTs to use technology more in instructional practices and help them to implement technology plans into the classroom (Wright & Wilson, 2011). Bell (2001) offered research questions for mathematics education that should be considered by researchers: "How do mathematics teacher educators structure methods courses so that preservice teachers learn how to use a variety of technologies and develop sound pedagogy?" and "How do mathematics teacher educators prepare preservice teachers for the future, where emerging technologies will have implications for their roles and their curricula?" These questions highlight the importance of methods courses in which PSTs can increase their ability to integrate technology.

Teacher preparation programs have an important and critical role to prepare future teachers to use technology effectively. Course instructors consider the importance of using technology in teacher preparation program, and they should introduce the proper technology tools to PSTs in method courses during teacher preparation programs. The method course should be designed to prepare students to be knowledgeable, skilled, and comfortable at using technology with their future students, with the goal of increasing PSTs' knowledge and skill at using technologies in math instruction. When the use of technology is incorporated into methods courses, PSTs can be aware of which technologies are available for them in teaching mathematics, learn to use technology with different teaching strategies (Powers and Blubaugh, 2005).

The participants in this study were assigned to plan a lesson that required the use of technology. Pre-service teachers (PST) in the Elementary (PK-4 program), Middle-Level program (grades 4-6) and Secondary Mathematics (grades 7-12) program during the 2014-2015 school year in a University in the northeastern United States provided their lesson activities. The assignment in the method courses required PSTs to integrate selected technological tools in lessons (or instructional activities) for elementary, middle, and secondary levels mathematics classrooms. PSTs developed and/or created lesson activities using the graphing calculator, Smartboard, and the Internet as their main technological teaching tool. PSTs were asked permission for the researcher to use their lesson activities as data for this study. Data include 68 instructional activities overall, from PSTs in the PK-4 program (41), middle level (19), and secondary mathematics (8) program.

3.1 PK-4 Program

Forty-one (41) PSTs in elementary mathematics methods courses (entitled Numeracy Pedagogy PK-4) courses

during the Fall 2014 and Spring 2015 semesters agreed to participate in this study. Table 1 displays a summary of the specific technology resources PSTs selected for the elementary level technology activities. Note that all technological tools are only counted once in this table, even when two forms of technology were used. For example, using the NVLM website on the SmartBoard for a demonstration was reported as an Internet resource because NVLM is the primary technology resource for the lesson activity.

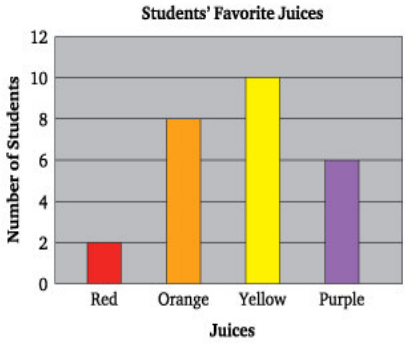
Table 1

Types of Technology Tools used in PSTs' Lesson Activities in PK-4.

Types of Technology	Technology Activities (41)
Internet sources	**41**
National Council of Teachers of Mathematics (NCTM) Illuminations	23
The National Library of Virtual Manipulatives (NLVM)	9
National Center for Educational Statistics (NCES)	4
Free.ed.gov	1
Datain theclassroom.org	1
Figurethis.org	1
Mathforum	1
Mathplayground	1
TOTAL	**41**

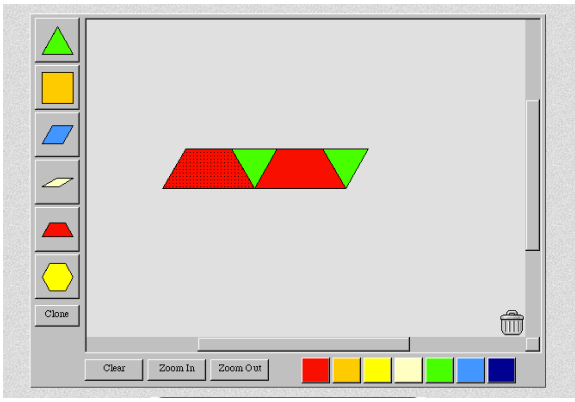
Table 1 clearly shows that PSTs frequently selected National Council of Teachers of Mathematics (NCTM) Illuminations (23/41, 56%), and rarely selected other resources such as Free.ed.gov (1/41), Datain theclassroom (1/41), figurethis.org (1/41), mathforum (1/41), and mathplayground (1/41) websites. The National Library of Virtual Manipulatives (NLVM) was selected nine times (22 %), and National Center for Educational Statistics (NCES) was selected four times (10 %) by elementary level PSTs to create technology activities. Figure 1 provides a screenshot of the most frequently selected Internet resources by elementary level PSTs. Figure 1a is an example of a screenshot of an NCTM activity, and Figure 1b is a screenshot of an NLVM activity. Both resources were frequently used throughout the PK-4 mathematics methods course.

1a.



NCTM Illuminations (n.d.-a). Retrieved from http://illuminations.nctm.org/Lesson.aspx?id=334

1b.



NLVM (n.d.-a). Retrieved from http://nlvm.usu.edu/en/nav/frames_asid_169_g_1_t_2.html

Figure 1. **A screenshot of an NCTM and NLVM activities from elementary PSTs.**

1a. This interactive site allows students to enter their own data and create graphs, or allows teachers and students to graph pre-selected data. Teachers or PSTs can create a bar graph or other types of graphs for students to view.

1b. This activity provides various colors and shapes to make patterns and allows creating a pattern by combining pattern blocks. This activity provides instructions such as: adding a block to the workspace, rotating a block, changing the color, removing, grouping, cloning, clearing the workspace, and zooming in and out.

3.2 Middle Level Mathematics

Seventeen (17) PSTs in a methods course entitled "Teaching Middle-Level Mathematics" agreed to participate in this study. Each PST was asked to submit one technology activities that contained the use of the SmartBoard, graphing calculator, or an Internet resource. Note that two PSTs submitted one additional technology activity, generating 19 technology activities for analysis in this study. Table 2 displays a summary of the type of technology used for the technology activities created by Middle Level PSTs within each broader category. Note that some technologies are only counted once in this table, even when two forms of technology were used (e.g., using NVLM on the SmartBoard for a demonstration).

Table 2
Types of Technology Tools used in PSTs' Lesson Activities in Middle Level

Types of Technology	Technology Activities
SmartBoard	**7**
PowerPoint	4
Smart Exchange website	2
Modern Chalkboard	1
Internet Resources	**6**
The National Library of Virtual Manipulatives (NLVM)	1
Mathplayground	3
Shodor.org	1
Sheppard Software Website	1
Graphing Calculator	**6**
Texas Instruments Website	1
Mathbits	2
Math Buffalo State	1
Only graphing calculator	2
TOTAL	**19**

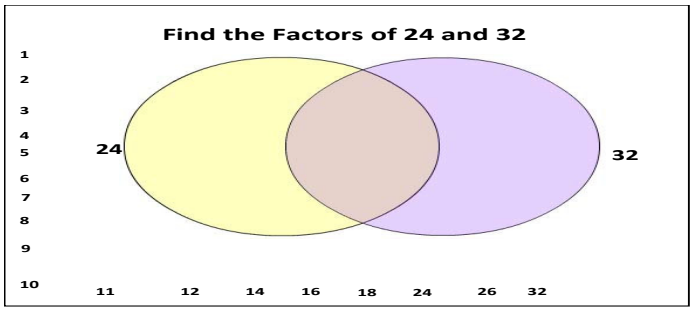
The data in the Table 2 demonstrate that seven lesson activities involve the use of the SmartBoard, six use Internet resources, and six use the Graphing Calculator.

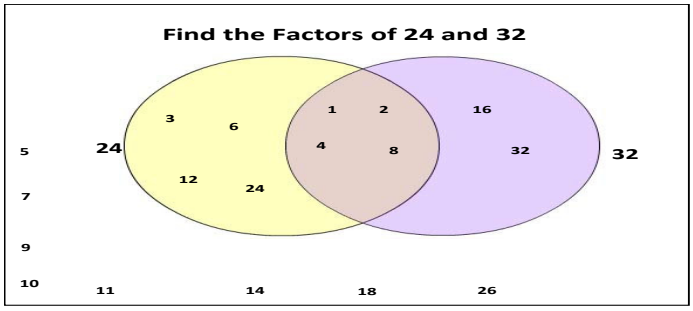
SmartBoard (Interactive White Board). Four technology activities included only the SmartBoard with no additional tools or resources. PSTs used the SmartBoard to present the lesson through slides they had created. Two lesson activities included the Smart Exchange website, and one activity used the Modern Chalkboard site to be displayed on the SmartBoard to do the instructional activities.

Internet Resources. Three PSTs used the Mathplayground website as an Internet resource. Each of The National Library of Virtual Manipulatives (NLVM) website, Shodor website, and Sheppard Software sites were used by middle-level PSTs only once.

Graphing Calculator. Two of the instructional activities were created by using the graphing calculator itself with no additional tools or resources. Two PSTs selected the Mathbits website as the basis of their instructional activities. The Texas Instruments (TI) website and Math Buffalo State website were each selected once. Figure 2 provides a screenshot of an activity from the data collection for the SmartBoard (Figure 2a), graphing calculator (Figure 2b), and Internet sources (Figure 2c).

2a. SmartBoard Activity





2b. Graphing Calculator Activity

Mathbits. (n.d.). Retrieved from http://mathbits.com/MathBits/TISection/Algebra1/Factoring.htm

Check Method 1:

Check factors/answer on the home screen in equation form.

Factor $x^2 - 12x + 36$. OR Find $(x - 6)^2$.

- Choose your "favorite" positive one-digit (for ease)

Integer value and store the value in x (do not pick 0 or 1) .

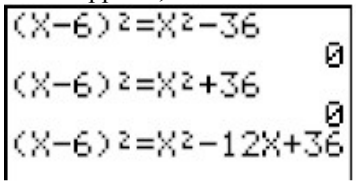
For example, to store a 7: **7 STO► x**

- Hit **ENTER.**
- nter the problem to be factored (or multiplied) and set "="
- To one of the possible answers (or the answer you want to check).

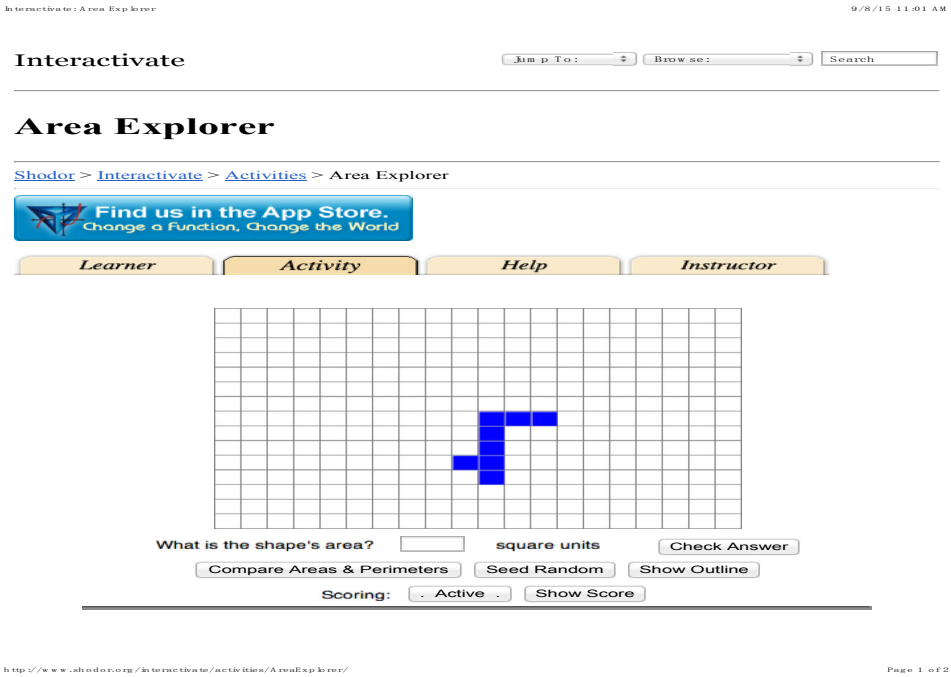
The "=" sign is under **2nd MATH (TEST) #1 =.**

- Hit **ENTER.**
- If a **0** appears, this is NOT the correct answer.

If a 1 appears, this IS the correct answer.



2c. Internet source activity



Shodor. (n.d.). Retrieved from http://www.shodor.org/interactivate/activities/AreaExplorer/

Figure 2. **A screenshot of activity from the data collection for SmartBoard, graphing calculator, and Internet.**

2a. This activity can help students to easily see which factors these two numbers have in common. In addition, there are numbers listed alongside the slide in order to provide additional support to students for generating possible factors. The numbers can serve as a scaffold for particular students, and numbers can easily be added or erased according to each student's needs.

2b. This activity would help students in the Unit to check their answers fro factoring. This activity helps students attempting to multiply or factoring algebraic expressions. This activity allows students to check their answers by using a calculator they will be able to determine if they are correct or not. This activity gives them a chance to review their work and determine where something might have gone wrong within their own work.

2c. Students can test their skill at calculating the area of a random shape by using this activity. A random figure is given to students, and they are allowed to enter a value for the area. Then the applet reports to students whether or not the answer is correct. Students can continue trying until reaching the correct answer.

3.3 Secondary Mathematics Course

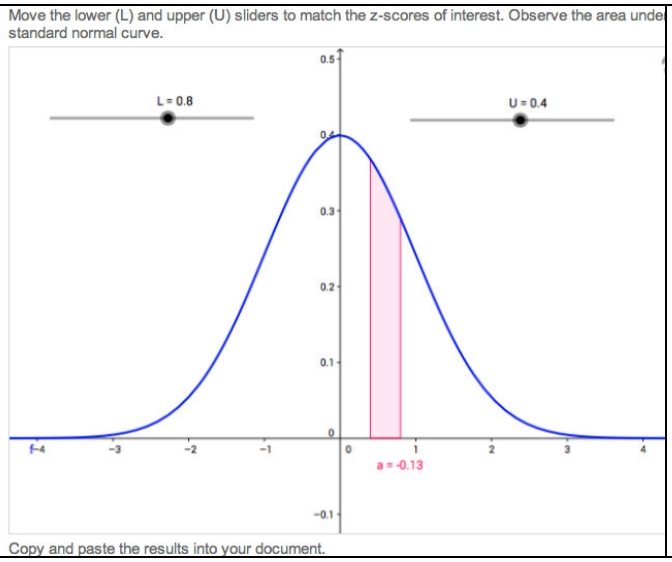
Eight PSTs in the "Teaching Secondary Mathematics" course participated, and eight technology activities were analyzed. Table 3 displays a summary of the type of technology used for the technology activities in this course within each broader category.

Table 3

Types of Technology Tools used in PSTs' Lesson Activity in Secondary Level

Types of Technology	Technology Activities (n = 8)
Internet resources	**8**
The National Library of Virtual Manipulatives (NLVM)	1
Geogebra (tube.geogebra)	4
Desmos	1
NCTM Illumination	1
Touchmathematics	1
TOTAL	**8**

Table 3 shows that secondary level PSTs created instructional activities through using Internet resources. Four PSTs selected the GeoGebra website, and other Internet resources were selected only once. In Figure 3, a screenshot of a GeoGebra activity from the data collection is provided.



Retrieved from http://tube.geogebra.org/student/b77111#material/20613

Figure 3. **A screenshot of a GeoGebra activity. (GeoGebra, n.d.-a)**

This activity can be used to help students understand the properties of z-scores and rules with the standard curve. The PST would use this site to help illustrate visual principals of the curve to reinforce conceptual ideas about the normal curve that may be hard to grasp. These concepts can easily be explored in conjunction with problems dealing with statistics. For example, students are able to see that the amount of data between the z-scores of -2 and -1 are not the same as the amount of data between the z-scores of 0 and -1. However, without this visual representation, this idea may not be completely clear. The visual aspect of this website makes these abstract ideas clearer for students.

4. Discussion

The National Council of Teachers of Mathematics (NCTM) Illuminations site and the National Library of Virtual Manipulatives (NLVM) site were frequently selected by PSTs, especially by elementary level PSTs. The NCTM Illuminations and NLVM site had been used by the classroom instructor and PSTs frequently during the method course in support of PSTs' own learning of mathematics and as resources PSTs might use to support their students' learning of mathematics (personal communication, October 15, 2015). NCTM and NVLM are popular web-based virtual manipulatives tools to support mathematical concepts through different representations. Also, Mathplayground, NCES, and GeoGebra were other popular sites selected by PSTs during the lesson plan or technology plan process. PSTs are interested in choosing appropriate technologies for teaching and learning based on their program (grade level) and assigned topics. For example, secondary level PSTs selected mostly the GeoGebra website, because their instructional topics included geometry and GeoGebra is a good source for geometry content. Elementary and middle-level PSTs mainly selected NCTM Illuminations and/or NVLM web page, because these web pages include great sources (lessons, interactives, e-examples, sketchpad, so on) of visual and exploratory mathematics lessons.

PSTs mostly selected technology activities with using the Internet. For example, while PSTs designed technology activities using the SmartBoard or graphing calculator, they also used the Internet to provide activities to demonstrate on the SmartBoard, or they found their activities about the graphing calculator on the Internet. Ronau et al. (2014) stated that Internet technologies (n=112) are the least addressed technology in 480 dissertations from 1968-2009. However, in the sample in this study, PSTs tended to use the Internet to create lesson activities.

Forgasz (2006) has highlighted that lack of teacher's knowledge of using technology and spending more time to prepare lesson plans negatively affect teacher's willingness to integrate technology into the classroom. Teachers need to be trained to use technology in the classroom, and this training should begin in teacher preparation programs. The recommendations that came out of this study can be used as a guide in mathematics teacher preparation programs. The results of this study can provide technology sources that mathematics teacher educators and future mathematics teachers can use in instruction. "However, teachers should not forget that technology is just a tool that helps students enrich their learning opportunities" (Unluol-Unal & Akcay, 2015, p.3016).

This study may provide the resources and/or materials for mathematics teacher educators to consider different technologies in and beyond mathematics. Students in today' classroom are digital natives because they have grown up in a technology-based world (Prensky, 2001). Today's PSTs have the ability to integrate

technology in their lesson plans and indicate that they are open to this idea, but need guidance to help them to integrate technology effectively. Teacher education programs must address not only pedagogical and content knowledge, but also the use of technology within specific pedagogy (e.g. learner-centered classrooms) and content (e.g., mathematics).

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