Technology-Enhanced Learning Experience

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April 10th, 2009

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Introduction

For our ETEC533 class: Technology in the Science and Mathematics Classroom, our group learned about Technology Enhanced Learning Experiences and as class ongoing assignment and also as a final project we built one. Our design project began with a decision work on making mathematics concepts relevant to real life situations on the eyes of the students and we decided to focus on geometry concepts in the Saskatchewan grade nine mathematics curriculum, more specifically, the concepts associated with the Pythagorean Theorem. The two month construction project has undergone many renovations. Indeed, some felt like complete demolitions and rebuilds. Throughout the design we remained focused on our main goals- to create a unit that supported the tenets of situated learning and to embed technology to achieve meaningful learning. The end product resulted in a very rich, positive, and effective learning experience for us. Nice intro

Problem Area

In our collective experience as students, math was engaging and fun because it sometimes seemed to be a game. It was sometimes a puzzle, sometimes a discovery, sometimes a way to reorganize variables or numbers, sometimes finding patterns and many times transforming words into equations to be solved. However, it was a game with no connection to real life. Teachers would remind us that it would be useful later on in life, but we could not see how. -good

Math classes often occur with students in rows, quietly observing the teacher demonstrate how to solve a math problem, and quietly repeating the procedure. A qualitative multi-case study performed by Andrew (2007) explored the teaching methods of four university mathematics instructors of future elementary teachers and compared them to the constructivist ideal. In the preliminary literature review of the study, the author finds that in mathematics classes where students sit quietly observing the teacher demonstrate how to solve the problem and then quietly repeating the procedure, "the student's responsibility is to arrive at the correct answer, and the teacher's role is to tell the student exactly how to arrive at the answer" (Andrew, 2007, p. 159). He suggests that teaching in this manner becomes predictable: teachers introduce a concept through lecture, select several representative examples to show students, ask students to try similar problems, and go around the class giving assistance to students having difficulties. According to Andrew, this kind of instruction is comfortable, predictable, and a long-standing tradition among teachers and learners, but carries other problems. Problems mentioned were that students finish school and still have mathematical misconceptions or have difficulties transferring the concepts to the larger world. An additional problem stated in the study is that students frequently see mathematics as a boring task not achieving its aim to visualize its richness and relevance in life. Andrew's study contained pre-observation and post-observation interviews, field notes taken during class observations, as well as a twelve-question survey measuring the agreement the pre-service teachers had with the components of a constructivist teacher. Results indicated that all instructors did want their students to be active during the course of the class period and that some of the instructors were slowly changing their teaching methods to be more in line with constructivism. Furthermore, the research found that the participants focused more on skills than topics, and believed the assignments were relevant to the students even though the topics could not be used in life outside the classroom-hmm, this leads one to wonder what the participants thought relevant means.

Furthermore, to be able to recall new mathematical concepts, activities containing topics that are situated in meaningful contexts are needed. Sedig (2007) conducted a study with 58 sixth grade students in an upper-middle school in Canada to investigate whether games could be designed to help children learn mathematics in an enjoyable and motivating way. A game based on Chinese tangrams was designed as an experiential learning environment where children were required to solve puzzles using a maximum number of moves and gradually shifting students' attention towards the representations of mathematical concepts, which later became a prominent part of the game. Pretests and posttest were taken, and a designed questionnaire was applied. The results of the study suggested that despite the difficulty of the math concepts involved, children found the learning process fun and engaging in this context. In addition, they presented significant improvement in their knowledge of transformation geometry concepts. The study concluded that many children do not enjoy mathematics and are not motivated to learn the mathematical concepts because of their initial encounters with the subject and the way it was presented to them. To be able to recall mathematical concepts, Sedig recommends the inclusion of activities with topics that are situated in meaningful contexts and that promote mindful learning of the embedded concepts. Your opinion (For eg. Do you think the tangrams are relevant to students?) Likewise, Kelly-Bryan (2006) writes an article on motivation and involvement of students through connections with high-interest topics that consequently improve attitudes toward complex content. She claims "any student who has ever played or watched a baseball game will look at the Pythagorean theorem - and the baseball diamond – differently" (p. 9). Connecting the class with what students enjoy outside of school will make students want to understand. In her article, students collected data reflecting player salaries, created graphs, calculated average earnings, compared the average and top earnings in various sports, drew conclusions, and wrote summaries about their findings, and in this way, were able to understand and apply the concepts, rather than memorize an out-of-context formula.-ok, and did the author comment on students unfamiliar with the game?

Moreover, for mathematics to be relevant in real life, its lessons must be connected to the students' cultural experiences. Ensign (2003) performed an analysis of mathematics work done in urban schools teaching culturally relevant mathematics. These schools used a "cultural connected" technique in which teachers focused on what students did in their lives outside of school and used the information as a basis for school work. Home experiences were connected to school's instruction. The research was conducted in second, third, and fifth grades in two urban schools in New Haven, Connecticut. Students were asked to write their own mathematical problems related to their out-of-school lives and ask classmates to solve the problems. The analysis showed that these students stayed more on task and were more interested in solving their personal math problems than those students working with their text's problems. Preliminary testing indicated a trend toward higher test scores on textbook unit tests when personal experiences were included in lessons versus when only isolated text problems were used. A noticeable increase in the interest and perception for mathematics was reported when students' out-of-school problems were included in classroom lessons. Students noted how they earned money at home, how they paid for items at stores, how their families used layaway to purchase items, and how they made sure they were not cheated when they made purchases. "The wider the gap between the students' home cultures and the culture of school, the more irrelevant the problems in math textbooks are for the students" (Ensign, 2003, p. 415).Interesting

Furthermore, a desirable pedagogical representation should highlight the features of the mathematics content and provide a familiar and accessible context. Chinese and U.S. teachers' constructions of pedagogical representations were investigated by Huang and Cai (2007). The study observed the patterns of participation and the way knowledge was constructed using videotaped lessons taken from a previous Learner's Perspective Study. A class with 55 seventh grade students from a Shanghai Chinese key school was compared to a California class containing 37 eighth grade students. The study found that the Chinese class used whole group instruction with frequent peer discussions. Its lessons started with a review of the previous lesson and ended with a summary of the key points.

The teacher in this scenario placed emphasis on procedures for solving linear equations. On the other hand, the U.S. class used group activities that included warm-up assignments related to the new topic, but not to the previous lesson, and no summary was presented at the end. In addition, the teacher emphasized multiple representations, as well as the transformation from one representation to another. Results showed the importance of constructing pedagogical representations to maximize student learning. These pedagogical representations are used by teachers and students in their classroom as expressions of mathematical knowledge that help explain concepts, relationships, connections, or problem solving processes. Huang and Cai suggest that the representations should highlight the features of the mathematics content the teacher wants to teach and suggest that the "representations should provide students with a familiar and accessible context in which they can extend and develop their capacity to reason and understand the idea" (Huang and Cai , 2007, p.65)-ok.

Matthews, Cooper, and Baturo (2007) report a teaching approach used in Australia that assists indigenous students to understand algebra through storytelling. They represent mathematical equations with stories that contextualize mathematical symbols drawn from their socio-cultural background. Domains such as sports, driving, art, and dance are utilized to build understanding of arithmetic symbolism and later are extended to algebraic symbolism. This approach focuses on familiar situations dealing with algebraic pattern and structure. Initially, the students explore the meaning of symbols and how symbols can be assembled in a story, such as symbols in paintings. Students explore simple addition stories by enacting the operation and then create their own symbols to represent the story using materials familiar to them. They then share the symbol systems with the group. Finally, the teacher modifies the story and the students have to find solutions so that the story makes sense once again, reinforcing their algebraic notions. Students are able to create their symbols with personal meaning and reinforce these personal meanings when they share with other students. Authors state that these experiences seem to provide students with a deeper understanding of algebra and that the implications apply to all learners (indigenous and nonindigenous) since it is a powerful way to assist all students in moving from arithmetic to algebra. "By taking away emphasis from foreign systems, it shifts the emphasis to algebraic pattern and structure within something that is familiar" (Matthews, Cooper, and Baturo, 2007, p.255).

Moreover, learning math concepts should go beyond the classroom problems and everyday life. Hiraoka & Yoshidda-Miuachi's (2007) study illustrates the four main aspects of a Japanese mathematics lesson: mathematical activities, problem solving, mathematical richness, and creativity. The authors describe a general mathematics class where the problem is first grasped and later solved individually. The problem is then developed in collaboration with everyone else in the class, and finally is deepened and concluded (an example would illuminate this description). Students work with one or very few problems during the 45-minute class time, and they solve the problem at different mathematical levels..meaning..?. Students are encouraged to give many solutions or explanations using various modes of representation. Their study analyzes an open lesson that was observed by 15 teachers ranging from novices to principals belonging to two elementary schools. The lesson was given to a class composed of 6 sixth graders and was part of the fraction multiplication and division unit. The teacher posed a question at the beginning of the lesson that triggered the opportunity for students to use fractions. Then the teacher brought students to broader levels of thought and to reflective thinking. The study gives importance to the development of student abilities and attitudes, taking into account both convergent and divergent thinking. The authors suggest that students discover a mathematical problem in everyday phenomena, such as, and solve it (convergent thinking), and, moreover, apply and develop the solution methods used to other contexts, producing broader richness of mathematical understanding (divergent thinking). In this way, student learning goes beyond the school context into everyday life where it could be perceived as useful.

After exploring contemporary scholarly literature, discussing instructional mathematical concerns, and looking back at our own past experiences as students, we identified a problem shared by many schools regarding mathematics: Students' mathematical knowledge is being measured on the amount of right answers they can give to the questions they are being asked, and they are not being taught on what they can do with the knowledge they have obtained. Instruction of mathematical concepts, for the most part, focuses on skills and forgets about their real life application. Mathematical class activities are usually not situated in meaningful contexts for the students, thus not allowing them to make connections to their everyday life (can list your citations here). Many learners do not enjoy mathematics nor see its relevance due to confusing and abstract encounters with the subject making them consider mathematics as a subject where out-of-context formulas are memorized and are used during class time only. Pedagogical representations provided by the teacher during instruction are not familiar to the students and have no connection to their cultural experiences. Students learn math problems but are not able to visualize them in everyday phenomena, nor are they able to apply them in relevant real life contexts. Traditional methods such as drill and practice make for good test results, however students need to find relevance in learning mathematics through connections with their everyday life to achieve deeper understanding of the concepts. Very nice review of the literature.

Design of a Learning Experience

Designing a learning environment begins with identifying what is to be learned and, reciprocally, the real world situations in which the activities occur (Barab, 1999). To address the problem of students not finding relevance of the mathematical concepts in everyday life, thus not finding mathematics learning meaningful, we have chosen to examine the Pythagorean Theorem and its applications in the areas of carpentry, construction, sports, surveying, and other areas that they may discover-excellent. There is growing evidence that problem-centered approaches, including mathematical contexts, "real world" contexts, or both-can promote learning of both skills and concepts (Schoen & Ziebarth, 1998). Traditional teaching has been missing opportunities for connections between subject matter and context, between school and life and between knowledge and application. Dale Parnell (1985) suggests that teaching must change to address these missed opportunities and to create the connections between high school mathematics, the workplace and everyday life. We hypothesize that making problems relevant will help ….Students will be able to distinguish between abstract definitions and concrete examples. They will be able to overcome common misconceptions such as generalizing that the Pythagorean Theorem applies to all triangles and forgetting that this theorem works only for right triangles. They will not just learn with the teacher's examples, but also from their classmates and their own examples. Students will be able to create meaningful representations and reflect on their understanding.

An overview of the unit that was created is listed below divided into four sections:

Unit Overview

1-Setting the Stage. Students make connections to their prior knowledge creating digital concept maps and post them in their blog. They are introduced to the Pythagorean Theorem and work in groups on a related activity solving initial problems.

2- Getting the Task. A video taken from the Jasper series-good is used to present the problem to the students who will work cooperatively in groups to find the solution. To retrieve necessary information on how to solve the problem, the students may access the textbook, the Internet, contact online experts, re-visit a computer copy of the video, watch supporting videos, and be scaffolded by the teacher. They are allowed to use a graphic calculator. Roles are chosen: the explorer (looks for information), the reporter (reports solutions to the teacher), and the captain (keeps the team focused on the problem). Using the discussion forum, the students will get together with classmates in the same role and share their experiences after solving the problem.

3-Building the Task. The students express their interests in the discussion forum and make new groups accordingly. They perform a warm-up activity with the assistance of the graphing calculator. Then, they use Flash to create an animated problem that is connected to their context. Students pick group roles once again.

4-Final Reflection. Students update the digital concept maps in the blog-nice move. They also post an entry in the blog reflecting on the learning. Using the discussion forum, the students will get together with classmates in the same role and share their experiences. Sounds like a good plan.

Effective use of technology is encouraged throughout the unit. Its main purpose is to enhance the learning experience and engage students in authentic mathematical tasks that will support knowledge acquisition, application, and refinement. The design uses digital concept maps, blogs, discussion forums, synchronous chat, graphing calculators, digital sketchpads, as well as video and audio applications. Digital concept maps help the student organize and represent knowledge. Blogs encourage the reflection and monitor learning. The discussion forums allow students to discuss, debate, and collaborate to achieve meaningful knowledge and work cooperatively. Synchronous chats help students communicate and solve problems in real time. Moreover, the teacher guides and scaffolds students in their learning, and they have the opportunity to connect online with "experts in the field". These experts, as members of the community, are part of the private, online membership and will make themselves available on webinars. Graphing calculators assist students in finding the solution to problems in a faster way. Students are able to visualize the problem in digital drawings provided by the digital sketchpads and share them through the Internet. The video and audio applications allow the students to acquire and represent knowledge and share it with others.

By integrating mathematics, problem solving, knowledge representation, reflection, and a community of practice, we are attempting to move the students from marks-driven learning into relevancy-driven learning-good. Becoming part of a community does not diminish an individual's sense of self but rather the individual becomes more part of the community and the self becomes larger just by being participatory (Barab, 1999). Students achieve higher understanding of the concepts and their use within the environment since they are enriched with the collaboration of the community's members, connections to real life, and their own responsibility for teaching and learning.

An understanding of the principles of mathematics and a working knowledge of numeracy and its functions is essential in today's society. Our constructivist design of our TELE is based on Edelson's (2001) Learning-for-Use (LFU) framework which presents the development of useful understanding through a three step process: a) motivation, where students experience a need for new knowledge; b) knowledge construction, consisting of the development of new understanding; and c) knowledge refinement, which encourages a useful application of knowledge. Its guidelines provide a design of activities that potentially contribute to the building of mathematical knowledge. It combines computer-supported activities that allow students to make connections to prior knowledge, collaborate with other learners, present and share artifacts, and reflect on learning. The following table presents the LFU model according to our design:

Three Steps in the LFU Model

LFU Steps	Process	Pythagorean Theorem Unit	Technologies
Motivate	Experience Demand	Students need to solve a real-life problem where a demand for further knowledge on the Pythagorean Theorem is required to be able to solve the problem	Jasper video
	Experience Curiosity	Students realize their gaps in their understanding of the Pythagorean Theorem and curiosity is elicited	Blogs, digital concept maps, discussion forums, digital sketchpads, graphing calculators
Construct	Observe	Students have access to direct access to explanations and examples of the Pythagorean Theorem in the form of text, audio, and video	Internet websites, supporting online videos
	Receive Communication	Students discuss with their classmates and are able to ask online experts about the Pythagorean Theorem	Discussion forums, webinars with online experts, digital sketchpads
Refine	Apply	Students create a digital	Macromedia Flash

		animation that exemplifies the use of the Pythagorean Theorem in their own context	software
	Reflect	Students reflect on their learning process and the knowledge they have acquired, modified, or reorganized	Blogs, digital concept maps, discussion forums

The design project is based on the situated cognition theory shifting the focus from the individual to the sociocultural setting and the activities of the people within that setting (Driscoll, 2005). The model of situated cognition as described by Brown, Collins and Duguid (1989) argues that meaningful learning only takes place if it is embedded in the social and physical context in which it will be used.-ok In other words, learners should be participating in authentic activities such as those being performed by practitioners in their everyday work, the idea being that knowledge is better gained through an apprenticeship model where the master models and teaches a skill to a novice-good. Cognitive apprenticeship supports learning in a domain by enabling students to acquire, develop, and use cognitive tools in authentic domain activity (Brown, Collins & Duguid, 1989). It provides an authentic context that reflects the way knowledge will be used in real life situations.

Herrington and Oliver (1995) discuss in detail the critical characteristics of situated learning which they describe as encircling the three main elements of this theory. The learner, the program and the implementation of the program are the three core elements enveloped in the critical characteristics. These nine characteristics are:

- Provide authentic context that reflect the way the knowledge will be used in real-life;
- Provide authentic activities;
- Provide access to expert performances and the modeling of processes;
- Provide multiple roles and perspectives;
- Support collaborative construction of knowledge;
- Provide coaching and scaffolding at critical times;
- Promote reflection to enable abstractions to be formed;
- Promote articulation to enable tacit knowledge to be made explicit;

- Provide for integrated assessment of learning within the tasks.

This apprenticeship model of situated cognition has roots in Vygotsky's (1978) Zone of Proximal Development (ZPD). The ZPD is the difference between what a learner can do without help and what he can do with help. Tasks should be designed to be slightly more difficult than the learner can handle independently but not so difficult that they can't be managed with the support and scaffolding of a more capable peer or teacher. Through coaching, direct feedback and modeling the learner's level of understanding is drawn closer to that of the level of the master. A critical aspect of this situated learning model is the notion of the apprentice observing the "community of practice" (Herrington & Oliver, 1995). It is also of critical importance that the master works collaboratively with the apprentice to achieve the goal of distributing expertise. It is imperative that the learning that occurs within the community of practice (Driscoll, 2005).

Important variables in designing the learning theory (especially one using interactive multimedia) are the protocols of assessment and of access (Herrington & Oliver, 1995). The designs used for these tools of assessment and access are embedded in the theory. The learning environment itself should provide purpose and motivation and the activities within this environment need to be discovered as well as solved. These tasks need not be subject specific and problems could to be ill defined, just as in real life situations where compromise and accommodation are the reality. In the real-world, the solution to a problem is rarely neat. Rarely is there a single answer, and rarely are the salient facts the only ones at our disposal (Herrington & Oliver, 1995)-yes. Rather than simply respond to problems posed by the teacher, students must learn to identify issues and problems on their own in the same way as the experts encounter problems in their specific areas. Generative learning, based on situated cognition, requires students to generate the relevant sub-problems and figure out what data is needed to satisfy those new sub-problems (Cognition and Technology Group at Vanderbilt, 1992)-good. Through group interactions in a large community of practice, students need to engage in argumentation and reflection and generate information based on their existing or refined knowledge as well as the other people's perspectives. "Self-generated information is better remembered than passively received information" (Cognition and Technology Group at Vanderbilt, 1992, p.68).

The concepts being learned need to have meaning and connection with the context and need to be grounded in the concrete situation in which they occur (Anderson, Reder, & Simon, 1996). The sociocultural setting and the activities of the people within that setting become important in the learning experience. This theory gives relevance to everyday existence, improvisation, coordination, and interactional happenings. It mostly addresses the interactive relations of people with their environment (Clancey, 1995, p. 13). Social beings search for meaning and gain knowledge in a matter of competence and active engagement in the world. Learning becomes a co-constitutive process in which all participants change and are transformed through their actions and relations in the world (Driscoll, 2005). Knowledge is no longer a thing or a set of descriptors or collection of facts and rules. Human knowledge develops in the course of activity, and especially on people's mental representations on what they are doing (Clancey, 1995). Under the situated learning theory, teaching abstract mathematical concepts which are not related to the learner's life becomes meaningless and of little use.

Pedagogical Goals of the TELE

The unit being developed in our TELE comes from the Saskatchewan mathematics curriculum (Saskatchewan Ministry of Education, 2008). The aim of this mathematics program is to graduate numerate individuals who value mathematics and appreciate its role in society. It places emphasis on providing students with the means and opportunity to cope adequately with the demands found in every day situations by teaching mathematics in a way that is relevant to the real world. The predicted audience for this unit is grade nine students taking the course Math 90 (Saskatchewan Ministry of Education, 2008). These students must master the classification of triangles by sides and angles. They should also be able to create digital animations, use the graphing calculator and digital sketchpad efficiently, and use the Internet, blogs, digital concept maps, and discussion threads proficiently.

The goals for the learning experience are presented in the following table:

<u>Foundational Objective</u>

- Demonstrate understanding of the Pythagorean Theorem concretely or pictorially and symbolically and using it in real life situations.

<u>Learning Goals</u>

This curriculum addresses five kinds of goals:

Content Understanding

Students will:

- Generalize the results of an investigation of the expression a^2+b^2=c^2
    - Concretely
    - Pictorially (using technology)
    - Symbolically
- Explore right and non-right triangles and generalize the relationship between the type of triangle and the Pythagorean Theorem.
- Explore right triangles using the Pythagorean Theorem to identify Pythagorean triples, hypothesize about the nature of triangles with side lengths that are multiples of the Pythagorean triples, and verify the hypothesis.
- Solve word problems using the Pythagorean Theorem.

Process skills

Students will learn to:

- Make connections between different mathematical concepts
- Use mathematical data to infer
- Make connections between mathematical concepts and real life situations
- Synthesize information
- Find a practical use of knowledge

Technology skills

Students will learn to:

- Represent knowledge in a digital concept map
- Play a video in the computer
- Collect data from the internet
- Communicate effectively through an asynchronous online forum
- Create an animation
- Create and maintain a blog
- Participate in a webinar with online experts
- Use a digital sketchpad to demonstrate understanding of the mathematical concepts and post sketches on the Internet
- Use a graphing calculator to find mathematical solutions

Metacognitive skills

Students learn to:

- Monitor their evolving understanding
- Reflect on the learning process
- Become active participants in their learning

Social skills

Students will:

- Collaborate with classmates and online experts to construct knowledge
- Work cooperatively in teams

Assessment pieces will allow the student to demonstrate learning. There are two major assignments in this course: 1) solving the problem presented in the video and 2) creating an animation that poses a contextual problem that requires the Pythagorean Theorem for its solution. The final grade for the unit will be determined by the two assignments, participation in the discussion forum, reflections posted in the blog, and a peer assessment. Assessments will have the following weight:

Animation:	30%
Solving Problem:	30%
Blog:	10%
Discussion Forum:	10%
Peer Evaluation:	20%

Digital Technologies

Our design of the Technology-Enhanced Learning Experience (TELE) uses a variety of technologies. Most of them are made available through Ning's (2009) online social network. This social network provides a space for students to enter their blogs, participate in discussion forums, watch supporting quicktime movies, and post group animations. The network is assisted with Elluminate's (2008) teleconferencing feature that facilitates real time communication with experts. Furthermore, Ning's blogs contain links to digital concept maps created and updated with CmapTools (2009). Additionally, the Jasper Series video (1992), The Right Angle, is available in a laser disc and is displayed with an LCD projector-good. Computer copies of the video are also available for students to watch afterwards as many times as needed. Moreover, Macromedia Flash (2009) software is used by students to create animations that are later posted in Ning's video section. Furthermore, graphic calculators and the Geometer Sketchpad software are used as tools to visualize and solve the geometric problems.

In the next paragraphs, each digital technology used in the design will be described focusing on its cognitive and social affordances.

Ning Social Network

An online social network has been developed and embedded into the course. A free service called Ning (2009) has been used to establish the network. Ning, which makes up the online component of the blended learning environment, allows students to discuss, write and collaborate throughout the course, giving them access to each other and their instructor outside classroom time through asynchronous (discussion boards, blogs) and synchronous (chat) communication.

Ning offers important cognitive affordances. Its discussion forums offer opportunities for students to make their ideas visible, share their thoughts, and build or reorganize knowledge-good. They give students the opportunity to compare, classify, and justify their points of view-good. Moreover, students may become aware of any misconceptions and may be able to fix them-yes, it's possible, but according to research, likely requires intervention with the teacher. Another available function is the blog section that plays a relevant role in the course activities. Students are asked to create and maintain a blog with their reflections on the learning process. It is the teacher's task to visit each student's blog, comment and provide feedback on the students writing every week (teacher's are able provide more comments to student blog entries if they want). The blog is used to assess whether students are applying their new knowledge about mathematical concepts and their applications in real life. Having students create and write their own blogs can create intrinsic motivation because they are publishing something about a subject of interest for their peers to read and comment on. In addition, Ning's video capabilities present Quicktime movies that support learning. They scaffold students who need more help with the concepts related to the Pythagorean Theorem by presenting a visual and auditory explanation on the concept. Students are able to understand the concept in a way that is different from the teacher's explanation allowing instruction to be tailored for visual learners.

The most important social affordance provided by Ning is the community of practice it offers to the class. Barab and Duffy (2000) suggest that learning be a community endeavor as opposed to an individual pursuit. A learning community is one where individuals are engaged in introducing, discussing and testing knowledge and where their main job is the collaborative production and improvement. The learning community is focused on and develops through social processes and discourse, acquiring and communicating knowledge and ideas. The importance of a learning community where ideas are discussed and understandings are enriched is critical to the design of effective practice fields (Scardamalia & Bereiter, 1994). Students are able to share pictures, videos, and links to websites of interest with their peers. Teachers and peers are able comment and provide feedback through discussion boards and blogs. Students not only share their points of view, but also have the opportunity to consider their classmates' perspectives and ideas. Meaning is a process of continual negotiation, and the quality and depth of this negotiation and understanding can only be determined in a social setting. Ning's blogs and discussion forums provide the students with the opportunity to publish their work to a world wide audience with the ability to receive feedback or comments on their ideas, thus promoting social construction of knowledge. Discussion forums allow students to voice their ideas and concerns. They share their thoughts regarding the content, discuss the information presented to them and learn from one another. In addition, the auditory and visual features in the Quicktime videos support the students in the discussions they have. Nicely written.

The Jasper Video

The Jasper video used in this learning experience is "The Right Angle" (1991) which is part of the Geometry section in the Jasper series. It comes in a laser disc and it is presented to the whole class using a projector. Additional computer copies are provided for the students so that they can go back as many times as needed and find information that they might require once they are working on finding a solution. The video presents a story with a challenge that students have to solve-do you think students will find the context relevant?. It contains information on topographic maps, scale and elevation concepts, geometry concepts, as well as angle and linear measurements, which they will need to apply to be able to find the solution.

The video offers many cognitive affordances. It incorporates real world map-reading skills with angle and linear measurements. In addition, the video poses a challenge or a complex problem that promotes reasoning. The students need to reason and solve the problem, rather than simply respond to problems posed by the teacher. The stories in the videos have all the required data embedded in them, but the students must learn to identify issues and problems on their own in the same way as the experts encounter problems in their specific areas. The video encourages generative learning based on the assumption that "self-generated information is better remembered than passively received information" (Cognitive and Technology Group at Vanderbilt, 1992, p.67). Generative learning requires students to generate relevant sub-problems and figure out what data is needed to satisfy them, just as in real life where situations bring problems that depend on other sub-problems to be solved first. The learner is active and independent in the learning process working on active construction and open-ended problems where concepts and procedures are connected. Moreover, the challenges posed are authentic and are situated in a real life context making students aware of the relevance of learning the mathematical concepts. Students are also able to concretize the abstract mathematical concepts into everyday mathematical necessities. In addition to all the cognitive affordances already mentioned, Jasper videos allow students to integrate cross-curricular knowledge (math, science, geography, social studies, history, literature, etc). The Right Angle video used for this unit incorporates math and social studies skills giving students the opportunity to see the interrelationship of concepts in real life and how the new knowledge is applied in different areas.

Jasper videos also offer social affordances. They are based on generative learning which finds relevance in group work. The creators of the series, the Cognitive and Technology Group at Vanderbilt (1992) recommend that students engage in argumentation and reflection as they try to use and then refine their existing knowledge and try to make sense of other points of view. Through discussions and collaboration about…, they can become aware of misconceptions and fix them. By working in groups, students can monitor each other and help themselves to remain on the right path toward solving the problem (sometimes group discussion produces misconceptions in members). The Jasper series provides opportunities for groups of students to create a problem structure based on peer interactions to be able to arrive at a solution. In many cases, the teacher first presents the video in a large group activity and encourages students to generate possible strategies to solve the problem. Then, the teacher divides the class in smaller groups to solve the problem. The teacher scaffolds groups that require assistance. The students are then able get together, report their findings to the other groups, and share their reasoning.

Finally, the Jasper series provides a context suitable for additional mathematical activities and lessons. Teachers are encouraged to develop their own additional problems or use the analogous problems that come with the disc to obtain in students a deeper understanding of the mathematical concepts and skills. Teachers can also find extension problems that can be used in class to broaden the learning experience into related subject areas.

CmapTools

CmapTools (2009) is software downloaded from the Internet that creates and manipulates digital two-dimensional concept maps. This is a graphical tool used for organizing and representing knowledge. It offers multiple cognitive affordances. The concepts or ideas are usually enclosed in circles or boxes, and are connected with cross links that show the relationship between concepts. These cross links show the learner's understanding of the relationships within the concepts. The maps help relate the learner's relevant prior knowledge to the material that is being learned and allow them to update the information whenever learning occurs. They can also be useful classroom tools for observing nuances of meaning, helping students organize their thinking, and summarizing subjects of study (Cañas, et al., 2004). The visual representation of the knowledge that is created as a map makes it easier for the student and the teacher to be aware of growth in learning. This feature makes them valuable evaluation tools since they help identify valid and invalid conceptions that the students may have acquired. The teacher may ask the students to start their concept maps guided by a focus question and the students can continue from there, identifying key concepts, and later building a preliminary concept map. It can be revised as needed. Concept maps are never finished. The students may add and reposition the concepts as many times as needed, as learning occurs and knowledge structures are added or reorganized in the learning process.

Moreover, digital concept maps such as the ones provided by CmapTools, offer advantages over non-digital forms. "They ease the process of moving concepts together with linking statements and the moving of groups of concepts and links to restructure the map" (Novak & Cañas, 2006, p.12). In addition, they can be modified just like text in a word processor, being able to change color, size, and font easily. The advantages of being digital bring social affordances. The facility of manipulating concepts as in a word processor allows the student to represent knowledge in a more visual way making it easier for the teacher, other students, and themselves to understand the knowledge being represented. In addition, it allows users at a distance to collaborate and construct concept maps together. Moreover, maps may be published and shared with other students in the Internet since they have the facility to be saved in the software's servers. Students may extend and clarify their concepts by easily creating links to resources such as photos, images, videos, webpages, graphs, tables, and text to further explain the content. Students then learn from other students' digital concept maps, as well as their linked information. As students share and collaborate with the concept maps they can scaffold each other when they realize that misconceptions are found or gaps in knowledge are preventing a student from acquiring relevant knowledge.

Elluminate

Elluminate (2009) is Web conferencing software. The application provides students and their instructor with the capability to speak to each other via the Internet in real-time. The software also provides a text messaging system, application sharing, and a whiteboard (Elluminate, 2009). The technology can be used to extend the physical boundaries of the classroom. Live discussion and dynamic interaction with others from around the globe may be introduced to the classroom. The result is engaged students, enhanced learning and improved comprehension.

Elluminate is a new technology creating an 'in-the-moment' virtual classroom direct to student desktops. This web-based audioconferencing software package enables instructors to have real-time discussions with students supported with PowerPoint slides, web sites, whiteboard mark-up capability and shared applications. Features of the software include:

- breakout rooms for small group discussion
- text messaging capability
- surveys and basic assessments
- incorporation of shared applications
- a whiteboard with markup tools for visuals
- sessions can be recorded and played back later by participants

Hoffman, Menchaca, Eichelberger, Cordeiro, Note-Gressard & Yong (2008) performed a study indicating that students found the synchronous chat available in Elluminate to be invaluable. One student stated "it's effective because it's interactive. I like to "be" at class and get answers from instructors right away." (Hoffman et al., 2008, pp. 178). The social affordance of immediate interaction between students, teacher and experts helps to create a "real" presence. Students use this online software to attend webinars given by online experts. Through these webinars, they are able to understand and clarify concepts contacting a different person other than the teacher or the classmates, with a totally different perspective. Elluminate substituted well for the in-class immediacy and presence that comes in a face-to-face classroom (Hoffman et al., 2008). Further to the Hoffman study was the clear indication from students that using Elluminate helped them feel connected to a learning community.

Geometer Sketchpad-I'm glad you included this.

Geometer's Sketchpad (2009) is a dynamic geometry software which offers several cognitive affordances. It allows students the ability to visualize the concepts related to the Pythagorean Theorem by constructing and manipulating images on the screen. Students are able to model and have an interactive experience with the two dimensional representations they have created. The use of dynamic software, such as Geometer's Sketchpad, allows students to easily create many examples of right triangles and squares. It allows students to make predictions about the proofs related to the Pythagorean Theorem and then easily test their conjectures. Visualization and spatial reasoning are also improved by interaction with computer animations and in other technological settings (Clements, Battista, Sarama & Swaminathan, 1997).

Mariotti (2000) looks at how students' view of geometry moves from an intuitive one, in which geometry is seen as a collection of evident properties, to a theoretical one, in which it is seen as a system of related statements that are validated by proof. The author sees this transition as being fostered by dynamic geometry software and affords visualization, exploration and the use of problem solving strategies. Knuth and Hartmann (2005) further state that the models created in Geometer's Sketchpad allow participants to engage in conceptual conversations about the mathematical ideas and problem solving methods. These class conversations focus more on the explanation and understanding of the mathematical concepts rather than on the technology and its applications.

Javasketchpad comes along with the Geometer Sketchpad. It is a very useful tool for both teaching and learning. Diagrams drawn by the dynamic geometry software Sketchpad can be converted into Javasketchpad diagrams. Teachers and students can then work with these diagrams without the software Sketchpad. The only thing needed is a Java-capable browser. JavaSketchpad offers several affordances including the ability to motivate and engage students through the interactive use of technology. Students are afforded the ability to investigate the geometric ideas associated with the Pythagorean Theorem and further develop their understanding of the concepts. Students are able to share their work in the Internet through Javasketch and see what others have created. They can communicate their ideas to others including the teacher. The sketch may be used as a tool for demonstration during discussion. Teachers can use the sketch and the accompanying discussion to check for deeper understanding.

Flash

Flash (2009) is an animation program used by students to pose an animated problem to be solved. A cognitive affordance of this technology is that it allows students to construct and represent their interpretation of the concepts in a creative way. The process of creating an animated problem allows the student to refine and reinforce the knowledge that has been learned in the unit. When a learner creates instructional material, such as the animation, for the use of another learner, the creator must master the concept to be able to instruct it. The animations also allow the student to represent a mathematical problem is his own context, thus concretizing abstract geometrical problems into everyday situations. Additionally, high-level students' understanding may be challenged in the creation of flash animations. They may include generative problems that extend further than the Pythagorean Theorem for its solution (Matos, Mustaro & Silveira, 2007). Since the focus is on real world applications, the teacher is able to extend the problem to other subject areas or raise the difficulty level of the problems.

When the students are creating the animation, there is collaboration amongst the group members and it hones on their social skills (Makar, 2003). Its social affordance allows for contributions from all students in the group and is open to different perspectives since it is done in cooperation. Students choose a role in the creation process making it possible that students with different abilities contribute in different ways. Technological capabilities, mathematical capabilities, creativity, all work together in this assignment. The teacher follows up on the contributions made by each team member according to the role they have chosen. As they are building the animation, they may also realize probable misconceptions and the team's discussions give them the opportunity to learn from others and revise their knowledge. They can also teach one another about how to perfect the Flash animations.

Graphing Calculator

The graphing calculator is a handheld calculator capable of plotting graphs, solving simultaneous equations and performing numerous other tasks with variables. It is a proven-effective, affordable handheld device with direct linkages to curricula (Roschelle, 2006).

The relatively low cost of graphing calculators allows that schools may purchase class sets allowing for a computer in every child's hand. Klopfer, Squire & Jenkins (2002, p.1) list five important educational affordances of graphing calculators:

a) portability –can take the computer to different sites and move around within a location
b) social interactivity – can exchange data and collaborate with other people face to face
c) context sensitivity– can gather data unique to the current location, environment, and time, including both real and simulated data
d) connectivity – can connect handhelds to data collection devices, other handhelds, and to a common network that creates a true shared environment
e) individuality – can provide unique scaffolding that is customized to the individual's path of investigation

Graphing calculators will help students studying the Pythagorean unit to find faster answers and be able to discuss how they arrived at those solutions. Lindbloom (2009) reports that the dynamic linking of multiple representations provides real-time, interactive feedback so students can try different problem-solving techniques with each other. Teachers can allow students to figure out the Pythagorean Theorem on their own by allowing them to work together and formulate their own strategies with the graphing calculator. Another possibility for the graphing calculator is that students can make up questions on the calculators and then pass them around and ask each other.

Generally, the calculators can all be linked together within the class so that the students can share the information (Aldon et al., 2008). A powerful tool is to have the graphic calculator connect to class device in the middle of the room and connect it to the teacher's computer and allow for further social affordances because the teacher can share data with students and conduct small questionnaires for the students. The teacher should allow the students to compare the results on their own. Lindbloom (2009) reports that the calculator is quick in response and students can find out immediately what they have done incorrectly.

Conclusion

We believe these technology-enhanced learning experiences are a fresh approach to the standard methods of teaching mathematical concepts, in this case, the Pythagorean Theorem. There is an increased demand to incorporate technologies into the teaching and learning process within meaningful contexts allowing the students to make connections to everyday life and bringing an improvement in attitudes and skills when the right environment is provided. That environment does not require all the latest bells and whistles but needs care to include a balanced, consistent mix of tools and strategies (Hoffman et al, 2008, pp 181). The implementation of this kind of environments "will depend on the ability of teachers to structure the learning environment in non-traditional ways, to merge new technology with new pedagogy, to develop socially active classrooms, encouraging cooperative interaction, collaborative learning, and group work" (UNESCO, 2008, p. 10), as well as contexts that are meaningful to students and that allow them to make connections to everyday life. These environments will hopefully engage the students into learning and becoming aware of the richness in mathematics in our everyday life.

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TECHNOLOGY-CONNECTED LESSON PLAN

Lesson Plan Number (Check one box)	1	2	3
	x		

Name:	Design Group C	**School:**	ETEC 533 Academy

Lesson Title:	Introduction to the Pythagorean Theorem
Lesson Overview:	Students make connections to their prior knowledge creating digital concept maps and post them in their blog. They use the geometer sketchpad to perform a right angle activity.
Proposed Duration:	1 day
Grade Level/Subject Area:	Grade nine geometry: Pythagorean Theorem
Student Profile:	Number of Students: 28 Grade 9 students
Skills/Objectives	<u>**Process skills**</u> Students will learn to: • Make connections between different mathematical concepts • Use mathematical data to infer • Make connections between mathematical concepts and real life situations • Synthesize information • Find a practical use of knowledge <u>**Technology skills**</u> Students will learn to: • Represent knowledge in a digital concept map • Create and maintain a blog • Use Geometer's Sketchpad to demonstrate understanding of the mathematical concepts • Use JavaSketchpad to post sketches to the internet <u>**Metacognitive skills**</u> Students learn to: • Monitor their evolving understanding • Reflect on the learning process • Become active participants in their learning
Curricular	<u>**Foundational Objective**</u>

	• Demonstrate understanding of the Pythagorean Theorem concretely or pictorially and symbolically and using it in real life situations.
	
	<u>Content Understanding.</u>
	Students will:
	• Generalize the results of an investigation of the expression a^2+b^2=c^2
	    ○ Concretely
	    ○ Pictorially (using technology)
	    ○ Symbolically
	• Explore right and non-right triangles and generalize the relationship between the type of triangle and the Pythagorean Theorem.
	• Explore right triangles using the Pythagorean Theorem to identify Pythagorean triples, hypothesize about the nature of triangles with side lengths that are multiples of the Pythagorean triples, and verify the hypothesis.
	• To determine if a triangle is a right triangle by using the converse of the Pythagorean Theorem.

Assessment	Attached Rubrics Rubric 5 – Blog
Technology Connections:	Students will learn to: • Represent knowledge in a digital concept map • Create and maintain a blog within the class ning: http://designc.ning.com/?xgsi=1 • Create dynamic geometry sketches using Geometer's Sketchpad software • Post dynamic geometry sketches to the internet using JavaSketchpad software
Materials:	• Laptops and stand alone computer machines with Internet connection • CmapTools software • Geometer Sketchpad software • JavaSketchpad software
Related URLs:	• Pythagoras Theory http://argyll.epsb.ca/jreed/math9/strand3/pythagoras.htm • The Pythagorean Theorem http://www.hfcrd.ab.ca/cyberhigh/Math/Math08/19/19.pdf

	• Solving Right Triangle Problems http://argyll.epsb.ca/jreed/math9/strand3/3105.htm
Procedures:	**Individual:** 1. **Students will create a digital concept map using CmapTools and describe what they know about the Pythagorean Theorem and post link to the concept map in class blog:** http://designc.ning.com/?xgsi=1 **2. Create an entry on the blog that answers the following questions:** • **What applications does the Pythagorean Theorem have in real life? Good-connected with your central issue** • **What would you like to learn about the Pythagorean theorem?** **3. Use Geometer's Sketchpad and JavaSketchpad to work through the activity "A Right Triangle with Squares" and post to blog.** http://www.keypress.com/x5596.xml Nice work
Classroom Management:	**Technology Management Strategy:-this is a good idea** • Tutorials on Ning available for Discussion Forums and Blogs. • CmapTools software downloaded in computers • Tutorial for CmapTools • Tutorial for Geometer Sketchpad • Geometer Sketchpad software downloaded in computers • JavaSketchpad software downloaded in computers

TECHNOLOGY-CONNECTED LESSON PLAN

Lesson Plan Number (Check one box)	1	2	3
		x	

Name:	Design Group C	**School:**	ETEC 533 Academy

Lesson Title:	Solving a Real Life Problem
Lesson Overview:	Students will solve a real life problem-great involving the Pythagorean Theorem concepts. A video taken from the Jasper series is used to present the problem to the students who will work cooperatively in groups of 3 to find the solution. To retrieve necessary information on how to solve the problem, the students may access the textbook, the Internet, contact online experts, play the video in the computer, and be scaffolded by the teacher. They are allowed to use the graphing calculator to solve the problem. Team roles are chosen by them: the explorer (looks for information), the reporter (reports solutions to the teacher), and the captain (keeps the team focused on the problem). Afterwards, they will reflect on their roles and their learning.
Proposed Duration:	3 days
Grade Level/Subject Area:	Grade nine geometry: Pythagorean Theorem
Student Profile:	Number of Students: 28 grade 9 students
Skills/Objectives	**Process skills** Students will learn to: • Make connections between different mathematical concepts • Use mathematical data to infer • Make connections between mathematical concepts and real life situations • Synthesize information • Find a practical use of knowledge **Technology skills** Students will learn to: • Represent knowledge in a digital concept map • Play a video in the computer • Collect data from the internet • Communicate effectively through an asynchronous online forum • Create and maintain a blog

	- Participate in a webinar with online experts - Use a graphing calculator to find mathematical solutions **<u>Metacognitive skills</u>** Students learn to: - Monitor their evolving understanding - Reflect on the learning process - Become active participants in their learning **<u>Social skills</u>** Students will: - Collaborate with classmates and online experts to construct knowledge - Work cooperatively in teams
Curricular	 **<u>Foundational Objective</u>** 4. Demonstrate understanding of the Pythagorean Theorem concretely or pictorially and symbolically and using it in real life situations. **<u>Content Understanding.</u>** Students will: 5. Generalize the results of an investigation of the expression a^2+b^2=c^2 a. Concretely b. Pictorially (using technology) c. Symbolically - Explore right and non-right triangles and generalize the relationship between the type of triangle and the Pythagorean Theorem. - Explore right triangles using the Pythagorean Theorem to identify Pythagorean triples, hypothesize about the nature of triangles with side lengths that are multiples of the Pythagorean triples, and verify the hypothesis. - To determine if a triangle is a right triangle by using the converse of the Pythagorean Theorem.
Assessment	See attached rubrics Rubric 1 - Solving the Problem Rubric 3 – Peer Evaluation

	Rubric 4 - Participation in Discussion Forum Rubric 5 - Blog
Technology Connections:	• Class Ning social network for discussion forums and blogs: http://designc.ning.com/?xgsi=1 • Elluminate virtual environment for webinars • Digital concept maps
Materials:	• 1 computer with Internet connection per group or laptops • Jasper laser disc: The Right Angle • Laser disc player • LCD projector • CmapTools software for digital concept maps • Graphing calculator
Related URLs:	• Working with Pythagorean Theory http://regentsprep.org/Regents/Math/fpyth/PracPyth.htm • Thinkquest – Pythagorean Theorem http://library.thinkquest.org/17038/admission/math/pythag-question.html • Pythagoras' Crazy Theorem http://www.funtrivia.com/playquiz/quiz2049161776b68.html
Procedures:	**Whole Group:** **1. Ask leading questions:** ○ What are some applications in real life or in nature of the Pythagorean Theorem? ○ What are some geometry and algebra concepts that you must know in order to understand the Pythagorean Theorem? **2. Show Jasper video "The Right Angle" to class using the projector** **3. Discuss answers to leading questions as a class** **4. Brainstorm strategies that will help solve the problem**

	Small Group:
	
	1. **Break into groups assigned by teacher**
	2. **Brainstorm ideas to solve the problem**
	3. **Look for information using:**
	    • **Textbook**
	    • **Support videos in class ning**
	    • **Computer copy of Jasper video**
	    • **Internet sites**
	
	    •Introduction to the Pythagorean Theorem (Youtube)
	    http://www.youtube.com/watch?v=s9t7rNhaBp8
	
	    •Pythagorean Theorem
	    http://en.wikipedia.org/wiki/Pythagorean_theorem
	
	    •Pythagoras
	    http://www.ies.co.jp/math/java/geo/pythagoras.html
	
	    •Working With the Pythagorean Theorem
	    http://www.regentsprep.org/regents/math/fpyth/PracPyth.htm
	
	    • **Webinar with online expert using Elluminate chat (check date and time)**
	4. **Solve the problem as a group (graphing calculators are permitted)**
	5. **Use the discussion forum in the class ning:** http://designc.ning.com/?xgsi=1 **to explain how the group arrived at the solution**

	Individual: 1. **After solving the problem, perform peer evaluation using rubric** 2. **Through the discussion forum, students with same roles exchange experiences and ideas with one another** 3. **Update Concept Map with Cmaptools** 4. **Reflect on class blog about own learning:** http://designc.ning.com/?xgsi=1
Classroom Management:	**Technology Management Strategy:** • Jasper video will be loaded on to computers for students to review • Webinar available in Elluminate (check date and time) • Tutorial on how to use Elluminate • Tutorials on Ning available for Discussion Forums and Blogs • Support videos in video section of class ning
	Instructional Groups: Teacher will assign groups which will include one math expert, one tech expert and one with good working skills.

TECHNOLOGY-CONNECTED LESSON PLAN

Lesson Plan Number (Check one box)	1	2	3
			x

Name:	Design Group C	**School:**	ETEC 533 Academy

Lesson Title:	Creating an Animation
Lesson Overview:	Students will form groups according to common interests. They will perform a warm-up group activity using the graphic calculator. Then they will create an animation that involves the Pythagorean Theorem concepts in their own context. Afterwards, they will reflect on their roles and on their learning.
Proposed Duration:	3 days
Grade Level/Subject Area:	Grade nine geometry: Pythagorean Theorem
Student Profile:	Number of Students: 28 Grade 9 students
Skills/Objectives	**<u>Process skills</u>** Students will learn to: • Make connections between different mathematical concepts • Use mathematical data to infer • Make connections between mathematical concepts and real life situations • Synthesize information • Find a practical use of knowledge **<u>Technology skills</u>** Students will learn to: • Represent knowledge in a digital concept map • Communicate effectively through an asynchronous online forum • Create an animation • Create and maintain a blog • Collect data from the Internet • Use a graphing calculator effectively **<u>Metacognitive skills</u>** Students learn to: • Monitor their evolving understanding

	• Reflect on the learning process • Become active participants in their learning **Social skills** Students will: • Collaborate with classmates and online experts to construct knowledge • Work cooperatively in teams
Curricular	**Foundational Objective** 6. Demonstrate understanding of the Pythagorean Theorem concretely or pictorially and symbolically and using it in real life situations. **Content Understanding.** Students will: 7. Generalize the results of an investigation of the expression a^2+b^2=c^2 a. Concretely b. Pictorially (using technology) c. Symbolically • Explore right and non-right triangles and generalize the relationship between the type of triangle and the Pythagorean Theorem. • Explore right triangles using the Pythagorean Theorem to identify Pythagorean triples, hypothesize about the nature of triangles with side lengths that are multiples of the Pythagorean triples, and verify the hypothesis. • To determine if a triangle is a right triangle by using the converse of the Pythagorean Theorem.
Assessment	See attached rubrics: Rubric 2 - Creation of the Animation Rubric 3 – Peer Evaluation Rubric 4 - Participation in Discussion Forum Rubric 5 – Blog
Technology Connections:	• Ning social network for discussion forums and blogs:

	http://designc.ning.com/?xgsi=1 • digital concept maps • digital animations
Materials:	• 1 computer with Internet connection per group • Graphing calculator • Cmaptools software for digital concept maps • Macromedia Flash software for digital animations
Related URLs:	• Mathematics Warm-ups: Pythagorean Theorem http://712educators.about.com/blwarmmath6.htm • Sargent Park Math Zone: Pythagoras Word Problems http://sargentparkmathzone.blogspot.com/2007/05/pythagoras-word-problems.html • Word Problem Excercises: Pythagorean Theorem http://www.algebralab.org/practice/practice.aspx?file=word_pythagoreantheorem.xml

<table>
<tr><td>Procedures:</td><td>Small Group:

Discuss interests in the discussion forum in class ning: http://designc.ning.com/?xgsi=1 and make own groups accordingly
Solve warm-up problem using graphing calculators

•Tulyn word problems
http://tulyn.com/wordproblems/pythagorean_theorem.htm
Use websites and brainstorm ideas for animation

•Pythagoras in everyday life
http://mathcentral.uregina.ca/QQ/database/QQ.09.04/tiffany1.html

•What are real life applications for the Pythagoras Theorem
http://answers.yahoo.com/question/index?qid=20060903005444AALlvvv
Use Macromedia Flash software to create an animation that depicts a problem connected to their own context
Post the animation in Ning’s video section
Use the discussion forum to explain the relation between the Pythagorean Theorem and the problem posed in the animation
</td></tr>
<tr><td></td><td>Individual:

Perform peer evaluation using rubric
Through the discussion forum, students will exchange experiences and share their learning
Update Concept Map using CmapTools
Reflect on blog about own learning
</td></tr>
<tr><td>Classroom Management:</td><td>Technology Management Strategy:

Tutorials on Ning available for Discussion Forums and Blogs.
Tutorial on Ning available for Flash animations
</td></tr>
</table>

	Instructional Groups: Students pick their own groups of 3 students according to common interests discussed in forum

Great work!

Grade 9 Geometry: Pythagorean Theorem
Rubrics

Rubric 1 - Solving the Problem

	4	3	2	1
Mathematical Concepts	Work shows complete understanding of the Pythagorean Theorem	Work shows substantial understanding of the Pythagorean Theorem and used it to solve the problem	Work shows some understanding of the Pythagorean Theorem that is needed to solve the problem	Work shows very limited or no understanding of the Pythagorean Theorem that is needed to solve the problem
Mathematical Reasoning	Uses complex and refined mathematical reasoning. Word problem has been clearly identified and concretized into the correct equation.	Uses effective mathematical reasoning. Word problem has been identified and concretized into an equation.	Some evidence of mathematical reasoning. Word problem has been identified and concretized into the wrong equation.	Little evidence of mathematical reasoning. Word problem has not been clearly identified and /or there is no attempt to concretize it into an equation.
Mathematical Errors	90-100% of the steps and solutions have no mathematical errors.	Almost (85-89%) of the steps and solutions have no mathematical errors.	Most (75-84%) of the steps and solutions have no mathematical errors.	More than 75% of the steps and solutions have mathematical errors.
Completion	The problem was completed.	Most of the problem was completed.	A small part of the problem was completed.	No evidence of working with the problem.
Strategy/Procedures	Used an efficient and effective strategy to solve the	Used an effective strategy to solve the problem.	Used a not very effective strategy to solve the problem.	Did not use an effective strategy to solve the problem.

	problem.			

Rubric 2 - Create an Animation

	4	3	2	1
Mathematical Concepts	Animation demonstrates complete understanding of the Pythagorean Theorem.	Animation demonstrates substantial understanding of the Pythagorean Theorem.	Animation demonstrates some understanding of the Pythagorean Theorem needed to solve the problem.	Animation demonstrates very limited understanding of the underlying concepts of the Pythagorean Theorem needed to solve the problem.
Connection to real life and context	Animation depicts the mathematical concept in a real life situation connected to the students' context.	Animation depicts the mathematical concept in a situation that might be connected to the students' context but is not probable to happen in real-life.	Animation has little connection to real life and to students' context.	Animation does not have a connection to real life nor the students' context.
Problem Posing	The problem in the animation is very detailed and clear.	The problem in the animation is clear.	The problem in the animation is a little difficult to understand, but includes critical components.	The problem in the animation is difficult to understand and is missing critical components.

Rubric 3 - Peer Evaluation

	4	3	2	1
Team Work	Student was an engaged partner, worked cooperatively throughout the assignment, and kept his role in	Student was an engaged partner, but had trouble working cooperatively and/or did not keep his role in	Student cooperated with other team members, but needed prompting to stay on-task.	Student did not work effectively with other team members.

	the team.	the team.		
Quality of Work	Provides work of the highest quality.	Provides high quality work.	Provides work that occasionally needs to be checked/redone by other group members to ensure quality.	Provides work that usually needs to be checked/redone by others to ensure quality.
Problem Solving	Actively looks and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems. Lets others do the work.

Rubric 4 - Participation in Discussion Forum

Criteria	**Exemplary (3)**	**Satisfactory (2)**	**Unsatisfactory (1)**
Quantity and Timeliness	Submits thoughtful posts early in the session and more than two responses to other learners at various times during the session.	Some posts are thoughtful and responses are made to other learners at various times during the session.	Posts are not thoughtful and/or responses to other learners are not found.
Demonstrates knowledge and understanding of content and applicability to real life situations	Post(s) and responses show evidence of knowledge and understanding of course content and applicability to real life situations and include other resources that extend the learning of the community.	Post(s) and responses show evidence of knowledge and understanding of course content and applicability to real life situations.	Post(s) and responses show little evidence of knowledge and understanding of course content and applicability to real life situations.
Generates learning within the community	Posts elicit responses and reflections from	Posts attempt to elicit responses and reflections from	Posts do not attempt to elicit responses and reflections from

	other learners and responses build upon and integrate multiple views from other learners to take the discussion deeper.	other learners and responses build upon the ideas of other learners to take the discussion deeper.	other learners and/or responses do not build upon the ideas of other learners to take the discussion deeper.

Rubric 5 - Blog

	Distinguished (4)	Proficient (3)	Apprentice (2)	Novice (1)
Overall blog use	Blog entries and comments are submitted, all of which are substantial and intuitive.	Blog entries and comments are submitted, though not all of them may give evidence of a substantial contribution.	Almost all required blog entries and comments have been completed.	Blog entries are few and generally simple retellings of personal events. No comments are made on blogs of others
Personal response to key concepts	Blog entries convey extensive evidence of a personal response to the issues raised in the communication, material and/or activities, and demonstrate the author's growth through reflection on learning, technology and society	Blog entries convey evidence of a personal response to the issues raised in the communication, material and/or activities and demonstrate that the author is capable of reflecting on learning, technology, and society	Blog entries convey little evidence of a personal response to the issues/concepts raised in the communication, material and/or activities	Blog entries show no personal response is made to the issues/concepts raised in the communication, material and/or activities
Monitor Understanding	States prior knowledge. States current knowledge. Identifies evidence that	States prior knowledge. States current knowledge. Shows that a change or	States prior knowledge. States current knowledge. No change is acknowledged	Prior and current knowledge are not stated.

	led to the change or addition in the new knowledge. Explains how the evidence is related to the old and new knowledge.	addition has occurred. Does not identify evidence to explain what led to the change or evidence that explains what led to the change contains significant gaps.	or change is noted but it is vague or flawed.	