

THE DESIGN AND DEVELOPMENT OF INTEL THINKING TOOLS TRAINING  
FOR IN-SERVICE TEACHERS

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## CHAPTER 1

### INTRODUCTION

Students in the 21<sup>st</sup> century need the ability to understand and work through complex issues and problems. They need to have collaborative skills as well as the ability to be critical thinkers. As educators, we need to strive to provide today's students with these skills so they may be progressive thinkers and doers when they leave their high schools. It is with these thoughts in mind that prompted the research and project that follows.

I work in a school district in a small town in southern Kansas. Medicine Lodge High School is in a rural setting and services approximately 260 students. The North Barber School District contains three buildings: Medicine Lodge Primary School, Medicine Lodge Middle School and Medicine Lodge High School. With all of these buildings combined, approximately 800 students' needs are being met. The North Barber district has tried to maintain a fairly up-to-date approach to integrating technology into their classrooms. However, as this study unfolded I found there was a weak link in the higher thinking skills and critical thinking skills.

I surveyed teachers in all three buildings as well as personally visited with some teachers and discovered that most did not feel their students were using higher thinking skills. Students tend to stay in the knowledge and comprehension levels of Bloom's Taxonomy. With this information in mind, I began to further research what had been used to encourage and motivate students to utilize higher thinking skills.

I formulated the following questions to guide my analysis of the problem, review of literature, and method of approaching the problem.

1. How comfortable are the teachers in U.S.D. # 254 with using technology in their classrooms?

2. What has been effective in instructing and facilitating students to use higher thinking skills? Does technology play a role in this process?
3. What specific steps and tools can teachers use to teach students to become critical thinkers?

## CHAPTER 2

### REVIEW OF THE LITERATURE

Students of the 21<sup>st</sup> century have more information available to them than any student in history; however, are they really utilizing the tools to acquire the skills they need to find information when it's needed to solve a particular problem or situation? After reading through several articles about standards for technology literacy, I determined that this issue needed to be a basis for literature review. Dugger (2001) states:

Our world will be very different 10 or 20 years from now. This is inevitable. However, we have a choice as to whether we march into that world with our eyes open, deciding for ourselves how we want it to be, or whether we let it push us along, as we remain ignorant and helpless to understand where we're going or why. Technological literacy will enable us to make a conscious choice. (p. 513)

It has been established that we are living in the information age and it is critical that our students can gather information and discern whether it is reliable information. Before they can think in the upper levels of Bloom's taxonomy, they need to know where and how to find the right information to solve problems. Is technology a tool to help them gain skills to solve problems? After more research, I still believe technology is an excellent tool, but students and teachers need to know how to use it to their advantage.

Developing an in-service for teachers to enable them to teach higher thinking skills and assess whether students are gaining these skills is the basis for my project. The teachers in our district were surveyed to determine their level of competence in integrating technology as a tool to teach higher level thinking skills, ascertain the need for this level of teaching and then develop

the training to enable teachers to instruct students. As a follow-up to the training, I will survey the teachers again to determine if there is any gain in skills.

Schools today need to provide technological literacy to all their students. This simply means that students will have the ability to use, manage, assess, and understand technology (Dugger, 2001). Because technology has become so embedded into our lives today, every person needs to become technologically literate. States are working toward developing standards for technology education, just as they have for other curriculum areas. The International Technology Education Association and its Technology for All Americans Project have developed and released *Standards for Technological Literacy: Content for the Study of Technology*, that focuses on what every student in grades K-12 should know and be able to do in order to be technologically literate (Dugger, 2001). Like other standards in education, these technology standards state what every child should know about using technology by the time they finish each grade level. Why am I developing this premise? The need for educators, especially older ones, to accept the importance of using technology daily in their classrooms to encourage and facilitate students in necessary skills to make them productive workers is critical.

According to the North Central Regional Educational Laboratory, technological literacy is defined as: knowledge about what technology is, how it works, what purposes it can serve, and how it can be used efficiently and effectively to achieve specific goals. Most states have accepted the NETS standards for technology which are divided into six categories. Within these categories, it is interesting to note that the last two involve higher thinking skills being addressed. The last two categories are:

- Use technology effectively to access, evaluate, process and synthesize information from a variety of sources.

- Use technology to identify and solve complex problems in real-world contexts.  
(NCREL, ISTE 2000, para. 2)

In March 2002, the Bertelsmann Foundation and the AOL Time Warner Foundation joined with experts from education, business, and government to convene an international 21<sup>st</sup> Century Literacy Summit (The Online Educator, 2003). In reviewing how education has been done in the past, it was determined that education had to move far beyond reading, writing, and arithmetic. Today's educators have to provide students with skills to be problem solvers and to continue learning beyond their formal education. One approach established was called the Big6 Skills which are used to teach information and technology skills. The Big6 Skills include:

1. Task Definition
2. Information Seeking Strategies
3. Location and Access
4. Use of Information
5. Synthesis
6. Evaluation

(Eisenberg, 2003, para. 12)

Isn't it interesting that two of the skills involved in the Big6 are synthesis and evaluation? These are also two of the skills that can be addressed through the higher thinking tools used in this project.

In the study completed by Hopson, Simms and Knezek, (2002) they found that the level of Bloom's taxonomy most improved in a technology rich environment was evaluation. This level is where the problem solving and critical

thinking skills are usually taught. The research that has already been completed illustrates the need for a shift in thinking for educators. Educators of today need to have a good definition for technology education, how they can incorporate it into their daily classes, and how it can be used to prepare students for the 21<sup>st</sup> century workforce.

One of the sites I visited was the Intel education site. Intel has conducted extensive research and training to enable teachers to incorporate technology into their classroom. After reading some their research, I realized one of the key ideas is to enhance what is already being done through the use of technology. Teachers should not use technology as an “add-on”, but as part of their teaching.

In the book *How People Learn*, Bransford, Brown, and Cocking (2000) conducted a study done with ninth-grade students to move them to higher-level thinking. The students made ordered lists regarding historical data they knew. As the year progressed and the students gained more knowledge, they would return to their lists, revise them, and elaborate on the information as it became more detailed. Through this process of developing lists, revising and elaborating the students were able to go beyond just learning historical facts to understanding and interpreting what history means to them and how it affects them. As they personalized their learning, it took on a more relevant meaning to each student.

Two other tools Intel developed helped students organize their thinking and reasoning through causal mapping and argumentation. Through the use of developing causal maps students can translate their knowledge to other cause-and-effect situations. The maps also help them visually see what they are compiling and think about their own thinking (Ibid, 2005).

In their article, Gopnik, Glymour, and Sobel (1999), conducted an in-depth study with causal maps. “Cognitive scientists have suggested that organisms solve the spatial inverse problem by constructing ‘cognitive maps’ of the special environment” Tolman 1932, O’Keefe & Nadel 1978, Gallistel 1990, Sec. 3, para. 2).

There are several unique features of cognitive maps that educators can utilize. Another name for a cognitive map is causal map; these maps contain several distinct features that enable students to see relationships. First, they provided non-egocentric representations for the learner to build on; second, they are coherent which enables the student to make predictions. Third, causal maps are learned which means the student can use information in one situation and recognize how it can be applied in another situation. These same researchers developed the hypothesis that human beings construct similar representations that capture the causal character of their environment. It is with this theory in mind, that theorists developed causal and spatial maps into software or internet tools to enable students to visually see how their thoughts affect other thoughts and ideas.

Cognitive maps have been used as organization tools, but using them to develop cause-and-effect tools will enhance the higher-thinking skills as students think about their thinking.

The other tool that Intel educators developed teaches students to reason and develop sound arguments. Several reasons to teach students to argue are to encourage them to use their higher thinking skills to validate their reasoning, and this skill is used in all content areas. All students like to argue, so why not teach them how to argue effectively. “If students receive explicit instruction and support in creating arguments, they are more likely to support their claims with the appropriate evidence and reasoning,” McNeill, Lizotte, Krajcik, and Marx, (2004, para. 2). “Engaging in argumentation in the classroom can help students take a more critical

stance when they are confronted with an argument; they will know how to evaluate the quality of what they read or hear, (Reznitskaya & Anderson, 2002, para 2). Critical thinking and evaluation is extremely important with students receiving an abundance of information each day.

With regard to considering the advantages of teaching students to move into the higher order of thinking, it is essential that educators believe this is necessary and also have the tools to teach students in the higher levels of thinking. In their article “Curriculum Design and Technology Integration.” Beaver and Moore (2004) indicate that many teachers believe technology is an add-on, rather than an integrated part of the daily lessons. They contend that instructors must become more comfortable and knowledgeable with using technology if it is going to be incorporated into their lessons. They discussed how too many times teachers are given an in-service on some new software or new method, but are not shown how to use it.

Teachers might need to revisit some of the educational theories in planning their lessons. When they go back to the “basics” of lesson planning around objectives and standards, they will see how easy it is to incorporate technology into the lessons. Technology rich lessons are not those that are taught just using a whiteboard, PowerPoint, or some other technology tool or software, but lessons in which the students use the computer software or internet to enhance their learning. A paradigm shift is in order for today’s teachers to truly incorporate technology. This can happen through training in which teachers actually get to develop lessons that are technology enhanced, not just adding some technology as an afterthought.

Beaver and Moore (2004) “ propose a model that asks teachers to aim for higher-order thinking skills and address varied learning styles as they plan new lessons or update previous ones, and then use the information to look for technology integration opportunities” (p.44). Students must learn basic knowledge to build upon, but they need to be encouraged and taught to

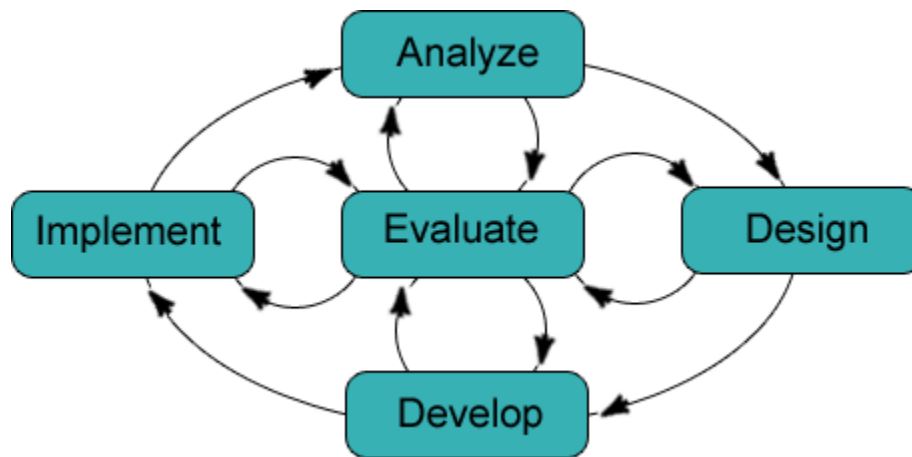
move beyond the knowledge and comprehension levels. “We can’t expect students to analyze and synthesize information unless they gather it first,” (Beaver & Moore, 2004, p.44). In training teachers to build technology rich lessons, they need to also consider the different learning styles of their students. “We would review the list of possible activities to be sure that each of the learning styles listed in Gardner’s multiple intelligences is represented” (Beaver and Moore, 2004, p.44).

In a time when teachers need to be addressing standards daily, developing lessons that move into the higher levels of thinking, addressing different learning styles, and incorporating technology into the learning itself, it makes sense to develop teacher training to help them reach these goals. This is the basis for developing the in-service; to help teachers realize how much it will benefit their students and prepare them for the future and to incorporate technology tools into their daily lessons to encourage students to utilize higher-order thinking.

## CHAPTER 3

## METHOD

I used the ADDIE (Analyze, Design, Develop, Implement, and Evaluate) model of instructional design to provide a framework for designing the staff development that would enable teachers to use the Intel tools to build lessons that guide students to utilize higher thinking skills to be better critical thinkers and problem solvers. Formative evaluation takes place after each step with a summative evaluation upon completion of the project.



The ADDIE Model

Adapted from Clark

### *Analysis*

A review of the literature indicated a need for teachers to have more training in integrating technology into their lessons, rather than use it as an “add-on” to be sure they were “using technology”. Many teachers do not feel competent to include technology with their lessons because they were developed without it and are not comfortable shifting the student learning to more of an acquiring mindset from a memorizing mindset.

Through the literature review, I also found that teachers really need to consider the standards and objectives more in their lesson planning. By incorporating these into their lesson plans they can better include some of the higher order of thinking skills such as analysis, synthesis and evaluation. Teaching these skills can include using causal maps to reinforce the students' ability to think at higher levels.

The literature review also revealed some confusion over terminology regarding technical education and educational technology. Several organizations have developed national standards that students need to master at each grade level to become technologically literate and these all included emphasis on critical thinking, higher thinking skills, and problem solving skills. This supported the need for more staff development in how to effectively teach students these skills.

Informal discussions with teachers in our district indicated a need for more teachers' training in incorporating computers into their daily lessons. I also developed a survey that was handed out to all the teachers in our district, as well as the teachers at Andale High School and those in the South Barber school district to get additional feedback on the need for getting students to move to higher levels of thinking. The results of the surveys conveyed the fact that many students do not practice higher thinking skills.

Based on the literature review, conversations with teachers, personal observations and the survey results, my goals for this project were to provide: (1) an awareness of the 21<sup>st</sup> century skills and the changes in teaching and learning that support them, (2) in-service training using the Intel Higher Order of Thinking Skills that are available to each teacher, and (3) a desire to incorporate technology into their daily lessons rather than using it as an add-on.

### *Design*

The learning objectives for participants in the project were to:

1. Identify 21<sup>st</sup> century skills.
2. Instruct teachers how to use the Intel Visual Ranking, Showing Evidence, and Seeing Reason Tools to develop problem based lessons that will encourage their students to use higher thinking skills.
3. Provide the teachers with resources to develop lessons that will incorporate technology daily, rather than use it as an “add-on”.

### *Develop*

A survey was distributed to the teachers in three school districts to provide some feedback as to their concerns and needs in developing lessons with higher thinking skills. After reviewing the surveys, a staff development was designed to present teachers with the tools that Intel has that are available online. Included in the staff development was information regarding creating classrooms that are conducive for teaching students to think.

Recognizing the need to encourage students to be lifelong learners involves creating an environment in which they learn to think about learning. Too many times, students want to rush through a lesson or assignment, come up with the solution or answer quickly, and move on to something else. Getting them to recognize the importance of learning to think was a difficult task to accomplish. I designed a part of the staff development to include creating that learning environment.

Due to the time constraints, I decided to provide an overview of the Intel Higher Thinking Tools and provide a teacher in-service with a teaser of the entire 40 hour workshop which will be accomplished when school is out. By doing this, they would see what was offered at the Intel site, why they needed a refresher in educational theories, and how all of these needs could be addressed at the coming workshop.

### *Implement*

My principal told me I could have a block of time during a staff development in-service day to present the overview of the Intel tools and the need for teachers to design lessons that encourage their students to use higher level thinking to develop better critical thinking skills and problem solving skills. However, the week before the in-service he changed his mind and decided the staff would visit schools that are using the one: one initiative and that I wouldn't be able to present to the teachers. An instructional designer must learn to work with obstacles that come up so I decided this was just another challenge I would have to work through. I contacted Andale High School and was invited to come and in-service their teachers on the higher thinking skills tools and later was also invited to in-service teachers in the South Barber School District on the higher thinking skills tools. Both of these groups were very receptive to the information and excited to see how they could implement this form of technology into their lessons.

Emphasis during this time was on creating a strong thinking environment in the classroom, reviewing educational theories and their relevance to higher thinking skills, and experimenting with the Intel tools. Teachers were able to experience the vitality gained from collaborating with peers. They were asked to work in teams to begin to develop a unit incorporating one of the Intel tools: visual ranking, showing evidence or seeing reason. The

Andale teachers were familiar with the Intel tools, but the South Barber teachers weren't aware of them. Time was spent exploring the tools and developing lessons. One of the key elements in developing units was to write essential, unit, and content questions. I asked them to use these questions as they developed their units. They also reviewed Bloom's Taxonomy, Marzano's Dimensions of Learning, and Costa and Kallick's 16 Habits of Mind. After reviewing these education theorists, they were better able to write questions that encouraged students to use higher level thinking skills.

### Visual Ranking

Visual Ranking is a tool (<http://www.intel.com/education/visualranking/index.htm>) used to compare and prioritize ideas. This tool is interactive as students view how others have ranked the items being discussed. However, the real advantage to this tool comes in enabling students to explain, justify and generalize why they have placed the items in the sequence they chose. They have to analyze and evaluate their thoughts as they are prioritizing the items. Teachers worked through a sample lesson to see how the tool could be used in their classroom.

### Seeing Reason

The Seeing Reason tool (<http://www97.intel.com/en/ThinkingTools/SeeingReason>) is used to investigate cause and effect situations. We discussed how to design a unit or project that would use this tool to help students sort through complex relationships. This tool supports cycles of investigation as they start researching and filling out the map created with this tool. As they continue to investigate, their map can and will change as new information is revealed. They learn to see the need to have evidence that supports their claim or who may be affected by a decision that is made. When students use this tool they learn to recognize causal factors and

evidence that may support relationships. Teachers were introduced to this tool and worked through an example project to learn how it could be implemented into their lessons or projects.

### Showing Evidence

Showing Evidence is Intel's newest higher thinking skills tool (<http://www.intel.com/education/showingevidence>) and is used to build well-structured arguments. Argumentation is about making claims and providing justification for those claims (Intel Teach to the Future, 2005). By teaching students argumentation skills, we are preparing them for real-world problems by enabling them to evaluate the quality of what they hear and read. It helps them develop their reasoning and critical thinking skills. When a statement is made it must be supported with documentation, not just personal opinion. Teachers were also introduced to this tool and given the opportunity to work through an example of using this tool to establish criteria to support a claim they made. Every argument consists of at least two parts: a claim and an evidence. When the argument is more complex there will be supporting evidence as well as counter evidence. A number of questions are addressed concerning the validity of the evidence such as whether it is biased, verifiable, factual or opinion, credible, accurate, student-created, or old.

Another survey was distributed to the teachers following the staff development to determine whether they felt any attitudes had changed regarding using technology on a daily basis in their classrooms. It also included statements regarding the Intel tools and whether they felt they could be used as a tool to encourage students to use higher level thinking skills.

*Evaluate*

Formative evaluations conducted throughout the project led to changes in design and development of the project. Teachers agreed that integrating technology was important, but felt there wasn't time to include it. Due to the time constraints in the building I teach in, it was difficult to demonstrate to them how to use the Intel tools to build lessons that would develop higher level thinking skills. During informal discussions, it was discovered they were not aware of the migration to 21<sup>st</sup> century skills and felt they were too busy developing lessons to prepare for the state assessments and state standards to have time to learn more about these skills.

Due to the problems in the district in which I originally planned to work, I selected two other districts. I didn't have the opportunity to have informal discussions with the Andale group, but did visit a few times with some of the South Barber teachers. Both groups of teachers did complete a survey before the in-service was conducted and then completed a final survey once they were finished.

The first survey revealed that most teachers felt there was a need to provide their students with more lessons that encouraged them to use higher level thinking and that incorporating technology would be a good method to accomplish this task. The final survey resulted in teachers feeling the in-service was helpful in understanding how the Intel tools could be used, but felt they needed more training to get comfortable in using them. The South Barber teachers also felt they needed more basic technology skills in order to use the internet effectively which opened the door for me to instruct them in another workshop on essential technology skills.

Both schools I visited and in-serviced were very receptive to the higher level thinking tools presented and felt they were easy to use and would help their students concentrate more on the analysis, synthesis, and evaluation levels of thinking. They were excited about the prospect

of more in-depth training on using these tools and developing entire units. Complete 40-hour training is planned for the teachers in both districts.

## CHAPTER 4

### RESULTS

Fifty-five teachers out of the three districts completed the initially administered survey. Twenty-five of those were from the Medicine Lodge district. They didn't get to actually go through the in-service, so they didn't complete the study. There were five elementary teachers, six middle school teachers and fourteen high school teachers that responded to the survey. I include this information because these teachers indicated that they were comfortable using the technology available to them, but 60% of them stated their student's struggle thinking beyond knowledge and comprehension levels. Forty-four percent of these teachers believed it is important for their students to use higher level thinking skills and 48% stated they would like to develop lessons that move students into higher level thinking. One of the initial objectives of this study was to provide teachers with the tools to develop lessons that would enable students to use higher level thinking skills and I believe the results of the survey with these teachers indicated there was a need for the training.

The remaining results were taken from the Andale high school teachers and the South Barber teachers. Andale High School is located 10 miles of Wichita, Kansas, and is very progressive in their technology skills. When I administered the initial survey and visited informally with them, I found that many of them were aware of Intel's training in the higher level thinking skills and one had completed the training. Eighteen teachers attended the in-service. Sixty-seven percent of those responding to the survey stated their student's struggle thinking beyond knowledge and comprehension levels. Fifty percent believed the internet was a useful tool to encourage students to use higher level thinking. Forty-four percent believe it is

important for students to move to higher level thinking and 50% wanted to develop lessons that would accomplish this task.

Following the in-service training, they completed another survey to determine if any of their needs or ideas had changed. The additional items were about the higher level thinking tools explained and experimented with during the in-service. Forty-four percent to 55% of the teachers responded that they were comfortable using these tools while 28% stated they needed more training. Their district is providing more training this summer for these teachers.

South Barber is a small district with two learning centers, an elementary/middle school center and the high school center. Many of these teachers have limited computer skills, but are anxious to learn and excited to experience what technology can offer them. There were five elementary teachers, two middle school teachers, and five high school teachers that responded to the initial survey and participated in the in-service. One first year teacher and one student teacher participated with the remainder being teachers with more than fifteen years of experience. One interesting phenomena with this group was that 67% stated their students struggle thinking beyond knowledge and comprehension levels with the remaining 33% stating this wasn't applicable. One principal and one librarian participated which could account for some of that response. On all the statements surveyed 33% to 42% responded that this wasn't applicable. This response is one I would like to research more and see if it changes with more training and experience.

Following the in-service these teachers also completed another survey that included statements regarding the higher level thinking tools they had just experienced. One responded that these weren't applicable, 50% stated they were comfortable developing lessons using the tools and 33% stated they needed more training.

Informal discussions following the training revealed the need for basic computer training as many of these teachers did not navigate the internet comfortably or use their computers for anything other than posting grades. They were very excited about the possibilities they saw in the tools they worked with in the in-service and were anxious to learn more, but stated they needed a basic class first which opened the door for me to provide basic training.

Incorporated into the in-service were the initial objectives for this project. Since I will be doing a five-day in-service this summer with the South Barber teachers, I will be able to go into more detail about the 21<sup>st</sup> century skills and provide the teachers with additional resources to help them use technology as they develop lessons.

## CHAPTER 5

### CONCLUSION

As an instructional designer, I met some challenges I hadn't anticipated. However, I believe they resulted in positive results and I learned how to handle those challenges. Due to the change in direction during the course of this project, the results were not what I had predicted, but were positive learning experiences for the teachers that participated.

Teachers have difficulty changing methods, if they have been teaching many years, as more than half of the teachers involved in this study have. Because of time limitations, they were excited at the prospect of incorporating tools that enhance higher level thinking skills that are easy to use and available without any additional software on the internet. The fact that they can develop their lessons and access them anywhere and the ease of including state standards and a variety of assessments was also a plus.

The project opened a door for me to provide additional in-service training in technology and also make a job change that will include technology support. It allowed me to be part of a progressive district that is truly excited with the changes they envision possible through technology. Initially, I felt I would have to convince the teachers of a need to make changes; in the end, the teachers I worked with were already at that point. They are ready to move ahead and are anxious for me to become part of their team and lead them.

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### Using Technology to Increase Higher Level Thinking

Rate the following statements according to your own comfort level for each one.

Question	Rating Scale				
	Not Comfortable	Somewhat Comfortable	Comfortable	Very Comfortable	Not Applicable
1. I use my computer daily for personal use as well as academic use.					
2. I teach with my computer daily.					
3. My students use the internet daily.					
4. My students work on the computer daily.					
5. My students write and think in Bloom's Analysis, Synthesis and Evaluation levels.					
6. My students struggle thinking beyond knowledge and comprehension levels.					
7. I use other types of technology at least once a week in my classroom.					
8. I find the internet to be a very useful tool for my student's higher level thinking skills.					
9. I believe it is important for students to move to higher level thinking.					
10. I would like to develop lessons that get students to think at higher levels.					

### Higher Level Thinking Through Technology

Rate the following statements according to your comfort level for each one.

Statement	Rating Scale				
	Not Comfortable	Somewhat Comfortable	Comfortable	Very Comfortable	Not Applicable
1. I use my computer daily for personal and academic use.					
2. I teach with my computer daily.					
3. My students use the internet daily.					
4. My students work on the computer daily.					
5. My students write and think in Bloom's Analysis, Synthesis and Evaluation levels frequently.					
6. My students struggle thinking beyond knowledge and comprehension levels.					
7. I use other types of technology at least once a week in my classroom.					
8. I find the internet to be a very useful tool for my student's higher level thinking skills.					
9. I believe it is important for students to move to higher level thinking.					
10. I am comfortable with developing lessons using Visual Ranking.					
11. I am comfortable developing lessons using Showing Evidence.					
12. I am comfortable developing lessons using Seeing Reason.					

