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Invigorating Science with Trade Books

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Abstract

Scientific literacy for all K-12 students is the main goal of science education as stated in many reform documents such as the National Science Education Standards (National Research Council, 1996) and Science for all Americans (American Association for the Advancement of Science, 1989). In order to obtain this goal, NSES suggests scientific inquiry as an effective pedagogical methodology. When embarking on scientific inquiries, important decisions must be made about which experiences and activities are best suited to engage students. Another critical aspect of successful inquiry learning is active student participation (NRC, 2000). Thus it is imperative that inquiry learning be student centered. Students must identify problems, pose questions, and design their own experiments. A number of studies (Short & Armstrong, 1993; Morrison & Terrell, 2008) have shown that an open or a full inquiry process generates greater student interest and engagement than a structured approach.

Approaching the study of science by utilizing trade books may increase the authenticity of students' learning experiences. Trade books, fiction and nonfiction literature, provide an in-depth and rich context of content; and they explore a variety of perspectives and topics (Morrison & Terrell, 2008). The emphasis on using trade books should be to enhance authentic science instruction through active student participation. Students will carefully read and pay attention to the literary components of the trade books, such as a main theme, characters, events, vocabulary, and summary of the content (Camp, 2000; Gunel, Hand, & McDermott, 2009). The use of trade books in teaching science provides students with authentic and perceptive inquiry experiences. Students using these books can find information to generate their own scientific questions thus encouraging divergent thinking (Short & Armstrong, 1993). Trade books also help students understand and retain difficult science concepts by providing colorful pictures and graphics (Kralina, 1993). These attributes distinguish trade books from textbooks thus making trade books more effective.

It is essential to determine how trade books with accurate science content can be productively incorporated into an overall science program. A common practice in science

teaching is to simply read trade books aloud to students at the beginning of the lesson in order to stimulate student interest and to provide a context which to formulate scientific inquiry and raise questions. (Ansberry & Morgan, 2005; Barman, 1992). In addition, trade books are used as reference resources for helping students in constructing explanations and drawing conclusions during scientific investigations (Morrison & Terrell, 2008; Rice, 2002). Trade books are also used for generating class discussions as students read, share and compare different titles.

Integration: Reading for Writing to Act

Some research (Gunel et al, 2009: Gunel, Hand, & Gunduz, 2006) suggests that students' understanding is enhanced when they share their learning through different forms of communication. Different forms of communication would include writing letters or scripts and acting out the scripts. After reading a trade book students can compose review summaries, create brochures, or write action letters. These end products can advocate a conclusion from an investigation and persuade the recipients to respond to the findings. Another activity is for students to write short scripts in which characters and actions represent the scientific concept they are examining in the books. (Hapgood & Palmisar, 2007: Harwood, MaKinster, Cruz, & Gabel, 2002).

Dramatic presentation is another effective means of engaging students to present their understanding of scientific knowledge. Students writing their own scripts based on trade books may also expand their scientific literacy. Writing enhances students' understanding of the science content, motivates them to think about the science content, and encourages them to reorganize concepts (Chamderlain & Crane, 2008). Later, the group of students present their creation to the class. Dramatizations are beneficial for student performers and audience members because it makes science more assessable and understandable. Visualization of science can stimulate interest as well as aid students recall. After the presentation class analysis and discussion allows for student exploration so they can establish relationships between the science content and their lives. Cross talk extends the experience of the individual and further develops their concrete understanding.

Making More Authentic Learning Experience

The crucial element is that students create their own understanding of science concepts through writings, drawings, cartoons, scripts or skits. The final product may vary by grade level. Students in lower grades can simply retell the story; present their drawings to the class with an accompanying explanation; performing one particular scene; or role-play from the book. Older students can dramatize their scripts or present their cartoons by using a "Cartoon Gallery", an arrangement in which groups of students walk around the classroom to see the cartoons. Cartoons are creatively attached to the classroom wall. Students also design background scenery, props, or masks to enhance the gallery.

Read-for-writing-to-act can be further elaborated into a group research activity for secondary students. Each group engages in research to find background knowledge for their chosen scientific concept. They create a PowerPoint file, portfolio, or poster. Figure 1 is an example of a lesson plan designed for the read to write for act. Writing is an important learning process, which enhances students' better understanding of science content especially when they write for a particular audience. The value to students' learning is further implemented when they must translate the meaning as they perceive it into suitable language (Gunel et al, 2009).

Figure 1. *Sample Lesson Plan of the Read to Write for Action: Reading, Writing, and Action!*

TN Standards Alignment:

Imbedded Inquiry

GLE 0807.Inq.1 Design and conduct open-ended scientific investigations.

GLE 0807.Inq.2 Use appropriate tools and techniques to gather, organize, analyze, and interpret data.

GLE 0807.Inq.3 Synthesize information to determine cause and effect relationships between evidence and explanations.

GLE 0807.Inq.4 Recognize possible sources of bias and error, alternative explanations, and questions for further exploration.

GLE 0807.Inq.5 Communicate scientific understanding

Biodiversity

GLE 0807.5.5 Describe the importance of maintaining the earth's biodiversity.

Grades: 6-8
Subjects: Integrated Curriculum (science, social studies, art, & language arts)
Main Theme: Environmental Issues, Biodiversity, & Natural Resources
Classroom Setting: Cooperative small group
Instructional Time: Three classes, each 45-50 minutes

Materials;
large news print papers, markers, construction papers, glues, tapes, scissors, large gift wrap, papers, strings, large trash bags, etc.

List of Trade books for the Lesson

- Earth Day – Hooray! By Stuart J. Murphy
- Joseph had a little overcoat By Simms Taback
- Miss Rumphius By Barbara Cooney
- And still the turtle watched By Sheila MacGill-Callahan
- Life in the oceans By Lucy Baker
- The great Kapok tree By Lynne Cherry
- The Lorax By Dr. Seuss

Procedures:

1. Choose your trade book for this activity.
2. Read the book with your group.
3. Identify a main theme, important concepts, and main characters from the book.
4. Construct *a concepts map*.
5. Brainstorm an important science concept from your reading. Your group will present the concept through (1) acting out a short drama. Later, (2) your group will conduct research in connection with the concept and present your findings with a PPT file.
6. Write a short drama script or skit (about 10 minutes) to deliver this concept to the class with your group.
7. Create other necessary items needed to perform your script or skit.
8. Enact your script or skit for the class.
9. Class Discussion: review

Extension of the activity:

1. Conduct research regarding your concept with your group
2. Create a PPT file (no more than 15 slides) that may include a title, names of your group, contents for explaining the scientific concept, interesting issues or facts connected with concept, etc.
3. Presentation to the class.
4. Class Discussion

Instructional Considerations

There are two important precautions in using this approach. The emphasis of scripts, skits, and plays should be on attaining and maintaining the science content and not on the dramatization itself (Hildebrand, 1996). This expectation should be established at the beginning of the lesson. Secondly, teachers must decide which type of writing is appropriate for their students. For lower grades a suggestion might be to start with individual students drawing a scene or character and then, with the teacher's help, involving the whole class in developing a short script. For middle and higher grades, students can draw a strip of cartoons or write a short script or skit. Also the construction of a concept map from their reading will aid in identifying main themes, events, or characters, and scientific concepts.

The identification of high quality trade books can be a tedious and difficult job. Some criterion for selecting high quality trade books include: accuracy of science content or event, reality of characters and passage of time, equity of culture, gender and race, and up-to-date information (Crowson & Hopper, 2009; Rice, 2002). Recently, many reliable resources (Table 1) have become available for teachers for selecting high quality, science trade books. These resources provide the current lists of trade books that have been reviewed by subject area specialists, classroom teachers, and librarians (Broemmel & Rearden, 2006). Teachers may find these resources helpful because they also provide accurate science concepts and appropriate lesson plans with the book's title.

Table 1. *Example of Resources for Selecting Trade Books in Teaching Science*

Resources	URL
NSTA: Outstanding Science Trade books for Students K–12	http://www.nsta.org/publications/ostb/
Salt Lake City School District	http://www.slc.k12.ut.us/staff/larmad/science/pages/scibklist.htm
Grammar Stage Science Book	http://www.redshift.com/~bonajo/sciencebooks.htm
Integrating Science with Children's Literature	http://www.terrificscience.org/freeresources/presentations/pdfs/Science-Lit-Book-List.pdf
Teacher's Choice 2010	http://www.reading.org/resources/booklists/teacherschoices.aspx

Assessment Ideas

Teachers can use students' products from the read to write for action as assessment tools. These students' products may include concepts maps (Figure 2), drawings, short scripts or skits (Figure 3), cartoons (Figure 4), performances, research presentations, reflection notes (Figure 5), or teacher observations. These products will be evaluated with appropriate rubrics. Reflection writing is an important product for the read-for-writing-to-act. Dewey (1933) considered the process of reflection to be a special form of problem solving, thinking to resolve an issue which involved active cognitive process. The reflective process will enhance students' scientific literacy by engaging them to review the whole process of this learning experience.

Figure 2. *Student Sample Concept Map with a Book, "Lorax"*

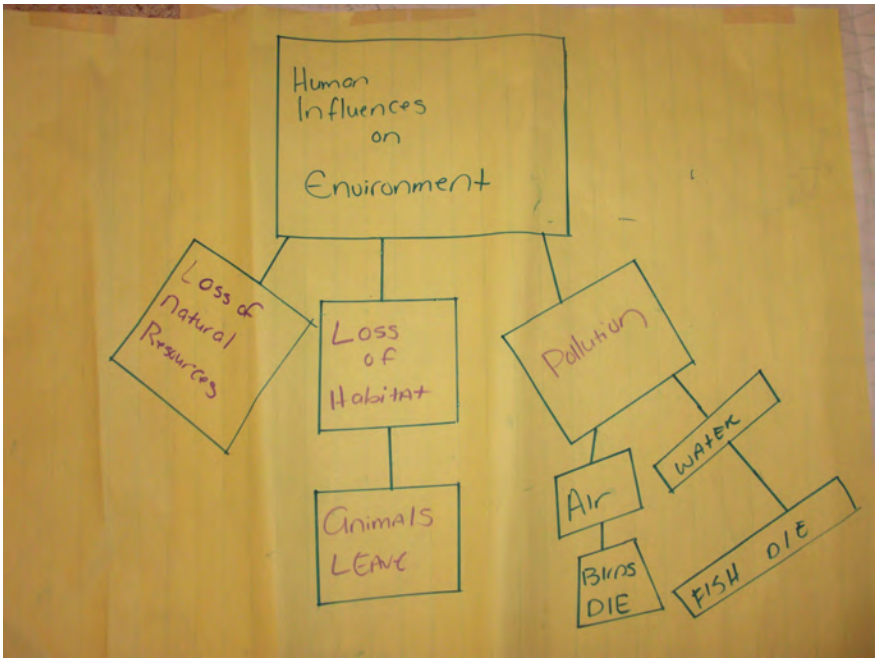

Figure 3. *Student Created Skit with a Book, "Lorax"*

Characters: LB, Oncler, Lorax

LB: *Hello there Mr. I heard a story that couldn't be true, but someone pointed me straight to you.*
Once-ler: *The story you speak of is very true; if you pay me well then I will share it to you.*
LB: *Here's a dime to share your time. My ears are open so let your story be spoken.*
Once-ler: *In a land that was filled with joy and peace, I found my home and began to make fleece.*
LB: *Fleece? Fleece? How could you make such a thing, and furthermore in a land with joy and peace, who would need a fleece??*
Once-ler: *Fleece you say how is that possible? With Truffula trees and family, no mission is impossible.*
Once-ler: *Truffula trees bore truffle fruit, Umm how the barbaloots loved that truffle fruit. But men paid more, so I made them suits.*
Once-ler: *There was a little odd man who tried to warn me he would always say…..*
Lorax: *I am the Lorax, and I speak for trees, you will cause much destruction with your greed.*
Once-ler: *In one ear and out the other I had plans, and he wasn't my mother.*
Once-ler: *The clean water was the habitat of the Humming fish, splashing and dashing what happy little fish, but my job was to grant man's every wish.*
Lorax: *I am the Lorax, and I speak for the tress, stop the destruction I'm begging you please!*
Once-ler: *I'm busy little man so leave me be while I continue my plan.*
Oncle-ler: *The fresh air gave way to the Swomee-Swans, but the more smog I created the more I got paid the bronze.*
Lorax: *I am the Lorax, and I spoke for the trees I try to tell you, but you were too blind to see. Now there are no more Truffula trees, barbaloots, humming fish, or swomme swans you see, they had to move because of you GREED!*
Once-ler: *The Lorax was right, but it was too late, everyone had taken flight. Now I'm alone in misery just me and my memories. I remember the message the Lorax left for me.*
LB: *Tell me Once-ler what message would that be?*
Once-ler: *"Unless"*
LB: *Unless? What does that mean?*
Once-ler: *I have thought about that for years, and now here's my deed, I give to you the last Truffula seed. Take great care, and one day you'll see all of the beauty from the Truffula tree.*

Figure 4. *Student Sample Cartoon*

Figure 5. *Sample Student Reflection*

The integrated curriculum activity was beneficial in many ways. The activity including reading, writing, researching, and acting gave a clear insight as to what the book we chose was about. The activity also allowed me to get to know my other classmates and how they worked. This activity made us realize our strengths and come together to execute the assignment. Angela was surprisingly good at writing the skit to where it rhymed and sounded like Dr. Seuss. She also put together a very informative PowerPoint with each of our research. I reached out to my artistic side and did the concept map and research on water pollution. Kyera was very good at creating props and delivering ideas. Tracy also created very neat props. Being in a group, you must rely on other people. This can be a positive thing and negative situation. Fortunately, my group did well and when one group member was unable to make it to the presentation we had Lashiante and Ann stepped in to help us out. They both came up with additional props and participated in the acting portion of our skit. It was very nice for them to adapt and help out.

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A Virtual Library for your Classroom: Social Studies on the Internet

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Abstract

Inquiry-based instruction in social studies began as a transformative movement virtually invented by people such as Shirley Engle, Donald Oliver, and James Shaver in the middle of the twentieth-century. The authors of this article contend that such inquiry –based instruction is not only relevant to twenty-first century social studies, but also even more important in the age of the internet. They attempt to show how four social studies websites can be used for student inquiry and research. Each of the websites are described and ways that teachers can utilize these websites to drive assessment and student engagement are suggested. The authors then offer criteria for selecting additional websites to use in the classroom. They contend that the internet offers many other websites that can spark students' interest in content subjects.

Nearly a half century ago, social studies educators suggested an emphasis on student-centered instruction as part of a massive reform effort. One of those early leaders was Shirley Engle (1960), who argued convincingly that students ought to be examining information in order to make critical decisions. In addition, the Harvard Social Studies Project in the 1960's demonstrated how students could and should be involved in critical inquiry (Bohan and Feinberg, 2008). These leaders set the tone for the standards movement in the 1990's and for National Council for the Social Studies' (NCSS) position statements dealing with developing effective citizens who have the skills to analyze data to make informed decisions (NCSS, 2001).

This article attempts to show how the pedagogical beliefs of these reformers are still fresh and useful in the modern high tech era. The authors of this article focus on how the internet can be used to engage students in inquiry-based approaches to learning. In an inquiry-based approach the teacher guides students' decision making through the use of questioning to critically examine the information made available through the latest computer technology.

The internet is an integral part of twenty-first century society. It provides up to the minute news, allows people to stay connected through e-mail and electronic social networking sites, such as Facebook and My Space, provides on-line shopping resources, and offers an entry into an endless array of research resources. There is a general agreement among social studies educators that students need to develop the skills to navigate and use the internet appropriately to

compete and prosper in the twenty-first century. Therefore, teachers should now be adapting instructional strategies to integrate technology into the classroom (NCSS, 2006). They can do this in a number of ways including:

- Monitoring use of Web Quests and similar structured problem solving strategies.
- Developing guided group activities in which a single computer is used by groups.
- Encouraging students to create power point presentations or other media presentations to disseminate information.
- Having students verify information in print resources using selected internet sources and vice versa.
- Developing guided lessons in which students are given tips for navigating through internet sites.
- Showing students how to access the content in the social studies websites.
- Leading students in the use of particular content related map sites.

The internet offers many resources to social studies teachers to help them develop the skills and learning traits students need to succeed in a contemporary society described by The Partnership for 21st Century Skills (2004). The websites described in this article contain various forms of rich media in which students interact to build various forms of media literacy (Partnership for 21st Century Skills, 2004). Students are able to draw on their creativity to construct their understanding of the content material in innovative ways through individual and group projects. Throughout the process, students build critical thinking skills by collaborating with peers when examining the material and scrutinizing the content of useful sites in an effort to construct meaning from various media. This process provides students with life skills such as the ability to work collaboratively with peers, the independence to be a self-directed learner, and the ability to adapt based on different academic challenges (Partnership for 21st Century Skills, 2004). Many of the skills described by the Partnership for 21st Century Skills can be accomplished by using websites that contain content appropriate material for students such as the four websites discussed in this article.

Recommendations for Using Social Studies Websites

Since students learn more in any content area when they are emotionally and mentally engaged interacting with the material, a few guidelines will help students use the websites in a more productive manner. One of the best ways for students to be engaged in the material is through exploring questions and trying to find solutions to problems. Students can learn how to evaluate sources, examine different points of view, and understand bias (NCSS, 2006). Teachers can aid students in making the most efficient use of their time by:

1. Examining the website first to determine appropriateness of the content and the organization, and then, to consider ways students can learn from that content.
2. Developing simple instructions to help students navigate the site.
3. Creating provocative questions and tasks that will give students reasons to find and analyze information at the site.
4. Developing opportunities to discuss these questions and tasks with peers.
5. Creating a variety of formats in which students can create products as evidence that they have understood and accomplished the objectives.

Below are descriptions of four web sites that we examined and suggestions that align with the guidelines above for using these websites in the middle school social studies classroom. The suggestions for each site have age and curriculum appropriate content.

The Living Room Candidate. (http://www.livingroomcandidate.org/).

This site has all of the presidential commercials from 1952 to 2008 for the Republican Party, Democratic Party, and major Independent Party candidates. Also, the site provides commentary about the issues of each presidential election and key campaign commercials (Museum of the Moving Image, 2008a). This site exemplifies several of the traits that make a website useful, including clear organization which makes it easy for students to navigate the website and access the content. The content is made available through various forms of media such as music, sound bites, and imagery, which can provoke stimulating questions and discussion in the social studies classroom. Inquiry activities can be framed around the role of elections in a democracy, specifically what influences the popular vote and the candidates' platform.

To use this site to engage students in inquiry activities around issues in a presidential election, the authors suggest using guided discussion to have students examine each party's stance on issues like education, abortion, the economy, or other issues the students want to pursue. This examination of issues allows students to see how the lives of Americans influence presidential campaigns. This can help students develop their own civic values and beliefs while also aligning instructional strategies with the goals for use of technology developed by The National Council for the Social Studies (2006).

Another way this site could be used in the classroom would be for the students to watch presidential commercials regarding parties' stance on an issue in different elections. For example, they might look at poverty and government spending. After viewing a 1964 commercial by President Johnson titled *Poverty*, and a 1992 commercial by President Bush titled *Favor Rev* 1, students could write three facts about each party's beliefs about what the role of government was in regards to dealing with poverty. From *Poverty*, one might conclude that most Democrats at the time of Johnson's election believed that being poor is the result of circumstance, that poverty is passed from one generation to the next, and that it is difficult for people to escape from poverty. They could also see that the Democrat conclusion was that the U.S. government must intervene. In this case, Johnson's War on Poverty offered to combat and prevent the spread of poverty giving every American a chance to succeed in this country (Museum of the Moving Image, 2008b).

Favor Rev 1 demonstrates how the Republicans, in 1992, viewed the Democratic approach to poverty. Students might learn that President Bush seemed to believe that the recipients of welfare became too dependent on government, resulting in a loss of the will to work and loss of a willingness to strive to achieve the American Dream (Museum of the Moving Image, 2008c). They might further infer that President Bush was saying that people needed to work more instead of relying on income from welfare.

After the students viewed the two commercials, the teacher can lead a discussion comparing and contrasting the ideas in each commercial and have the students share what they had concluded about the two political parties. From this discussion, one conclusion could be that the Democrats support the federal government's involvement through various interventions and programs to deal with social problems; whereas Republicans oppose many federal programs due to the cost placed on the federal government for these programs. This use of inquiry-based strategies, allows students to explore a central point that divides the two political parties. After discussing the commercials, the students could be placed in small groups to make a commercial for one of the political parties about the issue of poverty. Students construct their commercial after exploring a political parties' stance on poverty (or any key issue) through examining other

commercials, speeches, debates, and other forms of media. This activity allows students to be creative and provides an innovative form of assessment for the teacher to use to measure students' knowledge of the content.

19th Century U.S. Newspapers 1800-1899.

At this website, students have access to material previously unavailable. For example, it allows students to look at digitized archives of letters, newspapers, and journals. This, in turn, provides teachers with more primary sources to use in the classroom to engage students. Our example can be found through Infotrack, which is a database accessible at most universities and many colleges. We found it through the University of Tennessee's Hodges library website under databases, History and Classics. This website allows access to newspapers from major cities in each state during the nineteenth century. Reading the stories from these newspapers provide students with insights regarding thoughts and feelings of individuals that lived during a particular time period. These personal stories are more apt to engage students. The site also provides primary sources for teachers' use, especially in a U.S. history classroom. The letters, journals, and newspapers provide firsthand accounts of events, differing historical points of view, and examples of authors' biases. A teacher can design provocative questions that help students examine different points of view on a historical figure, issue, or event. For example at the site we found an article entitle *The Character of Thomas Jefferson* which the authors utilized to help students understand author bias.

Students were given a portion of the article and asked to look for examples of the author's bias using highlighters. A discussion followed in which students were to justify their reasoning for choosing their selection. For this exercise to be effective, the teacher may want to pre-teach specific vocabulary words related to bias or have the students use a website such as http://www.merriam-webster.com or http://www.thefreedictionary.com/.

Reading and discussing the biases found in the excerpts provides the opportunity for students to articulate their understanding of the material, examine different points of view, and to get feedback from classmates about their argument. By examining this article, the students gain an understanding of one historical viewpoint about a central figure in American politics. More able students could be asked to take a different point of view and write an article opposing this article about Thomas Jefferson. Such an activity allows students the ability to discover historical viewpoints by probing the contents of primary sources. If students have the opportunity to articulate the material through class discussion and writing assignments, they will have a firmer grasp of the content. Thus using the website in this way helps the students to see different points of view about historical figures and allows a teacher to design classroom discussion around exploring divergent perspectives on historical figures.

Ancient History.

The website http://www.sdst.org/shs/library/stuworld.html provides many useful sources for in-depth study of the ancient societies of Rome, Greece, Mesopotamia, and China. After clicking on a link for one of the ancient civilizations, a person is taken to another page with links that allow a person to explore different aspects of that civilization such as art, archeology, and government. A strength of this website is that it allows a teacher to develop a format for small-group discussions.

For example, in groups, students will pick one of the seven civilizations listed. Each student within the group will choose one aspect of the group's civilization to research. Since the

content at this site is engaging and interesting for students, the teacher can provide questions to guide their investigation of the civilization or allow the students to determine what content is most interesting to the student. This, of course, would depend on the students' prior experiences with inquiry approaches. Students become experts about their topic and teach their group members. As a group, they might develop a poster or a power point presentation for the whole class. This would involve groups in synthesizing all topics into one presentation. The next assignment could be for students to compare and contrast the civilizations based on the information they gained form the presentations. Perhaps the groups could be realigned so that all those who examined religion for their civilization would be put together to compare and contrast the religions.

History Matters.

History Matters, http://historymatters.gmu.edu, contains diverse types of primary sources of American history including letters, song lyrics, newspapers, and journals. This site is very similar to the Ancient History site but contains a larger quantity and divergent types of primary sources. The teacher can access primary sources on many topics and have the students analyze the key features of a document and do additional research into other primary sources about the same topic. One example of how this site could be used can be illustrated through looking at the song lyrics of *The Hunters of Kentucky,* a popular song of the 1820's that celebrated Andrew Jackson and his victory over the British in the War of 1812.

After reading the song lyrics, students would be asked to take a few minutes and write in their own words what they think is the main idea of the song. Then, the students would further explore the topic by doing research about the song and finding more information about people and events described in the song. After students share their findings and discuss the significance and merit of their findings, they could be asked to work in small groups to construct their own music video about the Battle of New Orleans, This activity allows the students to construct a meaningful product about their comprehension of the material and serves as assessment for the teacher.

Students would need access to the technology necessary for producing a video: a digital video camera, a computer, and computer software to edit the video. As a follow up, students would write a one page "director's cut" description explaining how their video captures important content of the events and people involved in the Battle of New Orleans. The added value of the activity is that students utilize their creativity and higher order thinking skills (NCSS, 2006). This site allows students to utilize the diversity of primary sources made available by the internet to better understand the public feelings of a time period.

Identifying Other Websites

Social studies instruction, especially that which engages middle level students in active inquiry and discussion, can benefit from using technology. Teachers should not be limited to the four internet sites described here. Rather they should use these sites as stepping stones to expand the resources they use. The authors now use these sites as examples to identify the traits that teachers should look for in quality sites.

1. Is the site well organized and easy to navigate?
2. Does the site contain a wealth of accurate information and ideas?
3. Does the site contain authentic multi-sensory materials, such as audio and video recordings, pictorial material, and other primary resources?
4. Can the site be related to legitimate goals and objectives of the social studies curriculum?
5. Does the site contain material at a level that students can read and understand?
6. Does the site attract and maintain student interest?
7. Does the site provoke questions and stimulate curiosity?

Reflections on the Internet and the Social Studies

An inquiry-based approach using websites such as those described here, can help students become more engaged in the material and classroom while also equipping students with the skills highlighted in Partnership for 21st Century Skills. Such mental and emotional engagement is essential to good social studies teaching because research shows that there is a positive relationship between student time on task and their achievement (AFCEC, 2010). Students need to be active agents in the classroom interacting with the content that they study instead of passive recipients of content knowledge. While the authors have strongly recommended using an inquiry approach to social studies education, they do not mean to imply that teachers should take a completely hands-off approach. Rather teachers should guide students in their decision making by asking questions. By modeling questions for and evoking questions from students and by making them want to find answers, the teacher is engaging the students in the material and challenging them to evaluate the usefulness of historical information.

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Using Thinking-based Learning in Middle School Science Classrooms

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Abstract

This article describes a framework for thinking-based learning. Three teachers' use of the framework to create problem-base units for their science curriculum is described. Instead of teachers telling the students about science or asking them to read about it, students reflected on science processes through these problem-based units. The units situated science instruction within the context of thinking-based learning, and therefore, enhanced students' content and process learning. Anecdotal results from teachers and students suggest an overall richer understanding of the processes of science and how science works.

National reform documents in the United States, such as *National Science Education Standards* and *Benchmarks for Science Literacy* (AAAS, 1993), recommend that teachers help K-12 students to not only acquire understandings of scientific knowledge and to develop skills needed to conduct scientific inquiries, but in addition, to gain an understanding of how scientists think about science. Gaining an understanding of how scientists think about science has been referred to as the Nature of Science or NOS (Abd-El-Khalick & Lederman, 2000; Gallagher, 1991; King, 1991; Lederman, 1992).

Knowing how to use inquiry to teach science and to develop attitudes associated with NOS is necessary but not enough. Likewise the study of the history of science has also proven to be ineffective in developing attitudes associated with NOS. An understanding of inquiry and NOS is best facilitated through an explicit reflective approach (Lederman, 2004) in which students have experiences upon which they can reflect on what they did, why they did it, and what implications this knowledge has for what they have produced. But, little instruction has been provided to teachers regarding how to effectively teach NOS in the science classroom.

Reflecting on the process or nature of science by students at the same time they are learning science calls for a different approach to teaching. Teachers need to help students think about process and content and to reflect upon their own thinking. This type of thinking not only involves critical thinking skills but metacognitive strategies as well. An approach called *thinking-based learning* (Swartz, Costa, Beyer, Reagan, & Kallick, 2008), in which the goal of instruction is to improve students' thinking and at the same time dramatically enhancing students' content understanding and learning might hold promise in accomplishing this task. Using the direct teaching of critical thinking skills provides a way of teaching in which, for example, alternative explanations of different conclusions are discussed and reflected upon.

Students discuss why they have chosen different questions and how their individual creativity and backgrounds influence their choices, understandings and interpretations. They reflect upon the effectiveness of their thinking and its applications to the science in which they have just participated. By discussing and reflecting on the process of science through metacognition within the instruction, the various aspects of the "doing" of science can be made visible to students (See Appendix C). This approach to teaching content, process, and metacognition, has been refined in the United States and in other countries such as Singapore and Australia in middle schools as well as at other levels of education (Swartz, 1996). This article describes how three middle school teachers from three different schools designed and taught thinking-based learning units in science. Each teacher explored a different problem. The teachers designed and taught these units with assistance from faculty at the National Center for Teaching Thinking (*www.nctt.net)*.

Thinking-based Learning in Science Using Problem-based Units

Problem-based units were selected in science because the process of scientific thinking is fundamentally aligned with those of problem solving. Standards of judgment require empirical evidence before ideas and claims are considered worthy of acceptance by the scientific community (Hagevik & Swartz, 2007). This is reflected in the problem-solving process as described by Swartz & Parks (1994). The first consideration is what is the problem and what facts are needed to define the problem. The second consideration is what are the options and possible solutions. Then, one must consider which options or solutions are best, what the consequences of each option might be, and what is the value of those consequences. The final consideration is describing how to solve the problem. For example when solving a problem in science, diagnosing the cause of the problem involves judging the reasonableness on the basis of observable evidence only when the variables have been identified that provide the competing causal possibilities. In addition predictions about future outcomes are based on supporting data and past patterns of events. Problems in science often require a variety of information from a variety of sources. Judging how reliable the information might be is an important part of scientific thinking. In fact, without learning the process of science, students will not be able to fully engage in scientific thought. At least five specific types of thinking are involved in solving problems. The types of thinking are: causal explanation, prediction, comparing and contrasting, determining the reliability and accuracy of sources of information, and problem solving itself. Figure 1 below gives one possible framework for a six-week thinking-based unit with a writing assessment in the seventh week.

Figure 1. Framework for Thinking-based Learning Using Problem-Based Units

Week No.	Content/Process/Critical Thinking Skill
1	Introduction to problem situation/generate list of problem questions/problem-identification
2	Study the problem and gather evidence about problem/generate list of possible solutions/extended brainstorming
3	Gather evidence to determine likely pro and con consequences/research or check information/reliability of sources of information
4	Determine the likely pro and con consequences/in depth class discussion and argumentation/prediction
5	Determine the importance of the consequences of the possible solutions/sequencing by rank/causal explanation
6	Judge which of the possible solutions is best using content information/defend these choices/compare and contrast
7	Write a recommendation explaining why the chosen solution is best/writing persuasive prose based on logical evidence

The teachers in this study realized that solving complex scientific problems required excellent thinking skills that are as important for students to learn as the content. So to begin, the teachers guided the students as they developed an overall question(s) with several associated sub questions (For an example, see Appendix B). Then the students were provided opportunities to apply the thinking strategies to guide them through the aspects of the science they were learning as they answered the problem questions. Students learned each thinking skill as they used content to answer the problem questions. The thinking skills were taught using verbal maps and graphic organizers or thinking maps (For an example, see Appendix D). Science content information was included in the thinking maps and the type of thinking map varied by the thinking skill. The thinking skills included a metacognitive strategy or "thinking about your thinking", through discussion or possibly writing in a thinking journal. Some of the questions a teacher might ask include: So what did you think about this strategy? Will you use it again? When might you use this again? How do you think you did? What might you do differently next time? Do you think scientists think this way? How do you know?

In these problem-based units, identifying and brainstorming ideas about the problem, is oftentimes followed by critically analyzing the reliability of the information. The remaining types of thinking, causal explanation, prediction, and comparing and contrasting compose the remainder of the unit. The advantage of using this framework (Swartz & Parks, 1994, p. 8) in science is that the critical thinking skills are purposefully used repeatedly by the students in different contexts throughout the unit and can be revisited as often as needed. In addition, as suggested for the learning of NOS (Akerson, Abd-El-Khalick, & Lederman, 2000), there is an emphasis on students' metacognitive reflection regarding thinking about and discussing the way they solved the problems to guide and improve the students' skills. Instead of teachers telling the students about NOS or asking to read about it, they experienced how science was done by continually reflecting on the process through these metacognitive strategies.

The Three Case Studies

Though different in content, the structure of the three different units was similar (see Figure 1). Each teacher substituted a problem-based unit using thinking-based learning for a traditional six week unit of study. Owens' 6th grade students studied an earth science unit on light, heat, sound, and minerals, while Whitaker's 7th grade students studied a biodiversity unit by investigating their school grounds and examining aerial photographs of the area, and Gronback's 8th grade science students studied the characteristics of waves in a physical science unit. In each case the teachers selected the overall problem question and then the students generated sub questions. The sub questions were categorized and then using a variety of methods such as examination of evidence, collection of new data, researching evidence using a variety of sources, observation and discussion with each other, arguing and defending ideas, and interviews of experts, to name a few, students sought solutions to their questions. At the end of their investigations, the solutions were shared and presented. Some strategies to sharing include: storytelling, persuasive essays, or presenting a technical report.

Case One – Earth Science, Owens' 6th grade

Owens' 6th grade students studied a unit on light, heat, sound, and minerals. They began with a story about colonists fleeing from the British, who had overrun the area, during the Revolutionary War. They found a cave in which to hide and realized that they may have to stay there for a long time. They can forage for food at night, but any exit during the day would lead to possible capture and probable death. The cave is typical for that region of the country in that it has the following characteristics: a river running though it, multiple passages, and stalactites and stalagmites. The students brainstormed questions such as, "Can the cave be disguised? How can we keep warm? What are the rocks like? How can we use light to survive?" They categorized their questions into heat in the cave, light in the cave, transmitting sound in the cave, and the characteristics of raw materials in the cave (See Appendix B). Then the students broke up into small collaborative learning groups to develop plans to seek solutions to their questions. They watched a brief video and collected information in their science journals on caves. They searched for evidence about the minerals in the cave, their properties and their uses. They conducted experiments to understand light and they investigated and tried various ways to use sound to communicate. Owens' students compared and contrasted characteristics of the rocks they found in the cave and each student created a diary of their adventures, taking on a role in the community. As new evidence for their possible solutions was discovered, they added it to their own personal stories. As students continually gathered information in a variety of ways, they judged whether the sources of the information were reliable. The students predicted the outcomes of their solutions, modified them continuously as they discussed, argued, and found additional sources of information. Owens' students became so involved that they even constructed a cave, based on an actual local cave, in their classroom. At the end of the unit the students presented the solutions to their questions using evidence to each other in the form of skits that they created. The student used their personal diaries to help them create the skits.

Case Two – Life Science, Whitaker's 7th grade

Whitaker announced to her class that they had been asked to take a close look at their school grounds in regard to its biodiversity. To do this, they were going to conduct an ecological analysis by looking at what lives there and how this relates to the non-living components of the environment. Based on direct observations and on maps and aerial photography, the students determined where they would locate $10m^2$ study plots on their school campus (Hagevik, 1999). Their overall problem question was "What is the relationship between the living and non-living components of the environment?" Students generated 15 to 20 questions they thought would help answer the overall question. Some of these included, "What is the relationship between the light and dark areas, moist and dry areas, areas of grass and trees, air temperature to soil temperature?" These questions were then categorized into abiotic, trees, animals, and vegetation cover (See Appendix A).

Whittaker's students decided to set up three permanent study plots on campus so they could studying how changes in the surrounding environment might affect their results over time. The students, in collaborative groups, conducted experiments outside using their plots and analyzed and compared their data to what others had found around similar questions. They questioned the reliability of their evidence. Students recorded their research and reflections in their science research journals. Students discussed if their solutions were effective, should be modified, or further investigated. When finished, the students wrote scientific reports based on their findings and presented them to each other. Based on these findings, they collectively prepared one report regarding how they could preserve and possibly improve the habitat on their school campus, which they presented to the principal.

Case Three – Physical Science, Gronback's 8th grade

In Gronback's 8th grade science classes they were studying the characteristics of waves in a physical science unit. Instead of using their textbooks to study waves, the teacher used a problem-based unit on noise in the cafeteria. The goal of this unit was to develop some recommendations regarding what could be done to lessen the noise. The overall problem question was, "What can be done to make the noise level in the cafeteria more comfortable and safe for all?" Students generated a variety of questions such as "What type of floor? How does noise travel? and What makes noise in the cafeteria?" Overall there were thirty questions regarding noise in the cafeteria! These questions were categorized into complaints, noise, cafeteria structure, students, and food served. Next, Gronback's students used causal explanation to make judgments regarding noise in the cafeteria. Students conducted interviews to answer questions such as, "Is it noisy every day in the cafeteria?" and they researched other questions such as, "How does sound travel?" and "How is the structure of the cafeteria related to sound?" The questions caused them to use multiple sources and to incorporate multiple types of information related to sound and engineering design. Gronback's students identified a variety of problems connected to noise and its reduction in the cafeteria. New issues emerged such as how much will it cost and how long will it take or how will it impact people who have to eat in the cafeteria? Gronback helped her students understand that a multiplicity of causal factors involved, which were both structural and people-related, that caused the noise problem. As students predicted the outcomes of their solutions and defended and argued them to each other, they discovered that they had different values and opinions on which were most important. Some favored a people solution whereas others favored a more acoustical solution. In the end,

the class presented a solution that was a combination between the two to the administrative team of the school in the form of a technical report.

These three cases represent examples of problem-based thinking units. In these cases, the teacher set the problem which substituted for the standard curriculum in science. But, with guidance, the students constructed questions to research themselves. Instead of a substitute for the standard curriculum, this approach can also be used as enrichment to an existing curriculum. In some schools, other teachers and students have become involved in the units. Since the units are interdisciplinary, entire teams can incorporate this type of approach into different subject areas covering various aspects of the units. For example, the social studies teacher could have covered the Revolutionary War and life in the late 1700's and students could have published their individual diaries of the experience in their language arts class in Owens' case.

Another possibility is for all of the teachers in a grade level, like 6th grade science, to study the problems at the same time. This is powerful since students from other teams discuss their solutions and conclusions as they learn similar content at the same time. In an intermediate school in New Zealand, the entire school is using problem-based thinking as their dominant model for curriculum (Swartz, et al., 2008). In this case, the curriculum for the school is thinking-based learning. These examples demonstrate how teachers and students can and are taking charge of their own thinking.

Outcomes

Teachers undertook this project to determine if students could learn at least the same amount of science and mathematics content in a problem-based unit as they learned through standard textbook learning and in the same amount of time. In interviews, the teachers expressed surprise to discover that they were able to cover the same amount of material, if not more, in approximately the same amount of time. Owens explained:

> *I saw the little light bulbs go off when the connections hit home. I think it was good because it really made them think and come up with a question and then figure out a way to solve it, which normally the information is all laid out for them. What I liked about this is that we did not know what we were going to get. We learned right along with them. I found that students needed as much time to reflect on what they learned as the teachers do.*

Teachers were pleased to report that not only did they feel that their students had achieved an acceptable level of understanding of concepts and principles, but in many cases they went beyond what they thought possible. Whitaker described her experience as:

> *It was amazing how the much the students learned as they found the information they needed to answer their own questions. I was concerned in the beginning that this was going to take more time and that they would learn less but the opposite is actually what happened.*

Teachers noted that students developed an initial understanding to the thinking skills and processes that had been integrated into the units. Gronback stated, "I think that a lot of the things they were learning, they were not even aware that they were learning them." All three of the teachers said that they felt the students became more observant and were able to identify relationships and patterns. Overall, Owens echoed the other teachers' thoughts when she said that her students had "…learned a great deal and benefited from the project. It was new to them." Whitaker noted that she overheard her students saying, "I have learned more in this project than any of the current things we are doing in school."

Additionally, students who were randomly selected to be interviewed remarked about the problem-based units that, "everybody was doing a different thing and there was no book to follow" and from another student, "It was not just reading out of the book, you actually got to go and do it." All students interviewed said that their ability to ask questions had improved. They said, "it is easier to do now and I can think of them (problem questions) more easily." Donald further explained that he now understands the steps to solving problems when he said, "I can now think about how to solve problem questions. I know how to do it and the steps of how to do it." Students commented that they solved problems over and over again during the units. Erik said, "I can now ask questions that make sense and have more depth." Carl said, "I look at different ways to answer questions now." Three students expressed a deeper understanding of asking questions when they said, "I learned you should ask a lot more questions when you do something that is complicated." Two students seemed to understand science better when they said, "I never knew there was that much stuff to science and I didn't realize how important it was when I started the project."

While student comments did not clearly identify whether or not their ability to solve problems had changed, their comments illustrate that students did have an idea of how to go about solving problems and that their ability to identify or formulate problem questions had improved. There was a dramatic difference between problem identification and the understanding of the steps of skillful problem solving from the beginning of the units to the end of the units as explained by the students in these interviews. Students commented that the units were longer and more involved than what they usually did in science. They began to see that science was not just a collection of facts but rather an in-depth investigation of problem questions to which there were no definitive answers.

Conclusion

The overall purpose of this study was to determine how using a coherent set of practices called *thinking-based learning* in the form of problem-based units in middle school classrooms affected the learning of science. Outcomes of interest include:

1. understanding of the process of science,
2. changes in instructional behaviors when studying science by investigating problems, and
3. the practice and learning of critical thinking skills while learning the basic concepts of science.

By situating science instruction within the context of process (i.e. critical thinking skills) in addition to reflection on those skills, process and content learning were enhanced. This led to a broadening of the appreciation of students in how science works. Through the clustering of thinking skills in science, more narrowly and oftentimes incorrect views of science were challenged.

While this study indicates that there is a good initial indication that thinking-based learning in science is a powerful vehicle for teaching concepts, processes, and thinking in science, additional research needs to be conducted on student learning and knowledge. Though the teachers did report that students went well beyond what was expected, there was no standardized quantitative data collected regarding student outcomes. What is clear though is that teaching thinking-based learning in the form of problem-based units allowed students to learn and practice the critical thinking skills necessary to use the scientific concepts and principles well, giving students practice in both as they solved authentic problems.

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Appendix A. Problem Questions and Conclusions

Whittaker's classes selected students' problem questions and conclusions

PROBLEM QUESTION	CONCLUSION
Is the temperature cooler near the trees or away from the trees?	The temperature near the tree was cooler than one meter away. We think it is because away from the tree gets more sunlight than close to the tree.
Does a larger tree make the air and soil around the tree warmer than the affect of a smaller tree on the air and soil around that tree?	The smaller trees were warmer. The largest trees were second and the medium trees coldest. Trees affect the soil and air temperature. The type of tree and the surrounding trees make a difference.
Does leaf litter insulate the soil it is covering?	Leaf litter does insulate the ground by a matter of 0.5 - 2.0^{o}C depending on the time of day and the duration of the sun hitting the ground.
How many blades of grass were there in each quadrate of the study site?	There were approximately 3,748,148.00 blades of grass in the study site. There was more grass near the woods than in quadrate 2.
Does the temperature actually affect the number of insects that can be found or just their location?	The insects seemed to be more frequently caught in the sixth trap next to some decaying logs in the woods.
Which ground cover contains the most insects?	The pine needle by far had the most insects followed by the grass.
Which animals occur in each quadrate and how does the ground cover affect them?	There were ants, leaves, grass, and clay in most of the pitfall traps.

Appendix B. Owens' Classes Problems to Solve

Overall Question: How can we use the cave to survive for an extended period of time and protect ourselves from our enemies at the same time?

Sub questions:

1. How will we get enough food to survive?
2. How will we get heat to keep us warm?
3. How are we going to get enough light into the cave?
4. How will we obtain medicine to make us better if we get sick?
5. How will we defend and attach through our knowledge of traps and weapons?
6. How are we going to get around the cave without being harmed or lost?
7. How will we communicate with each other?
8. How will we get enough fresh, clean air?
9. How will we entertain ourselves?
10. How will we defeat the British?
11. How will we find our way around inside the cave?

Owens' examples of problem questions from the thinking maps

The problem – How might I disguise the cave?
Possible solutions – Hide it with buses and shrubs and trees. Use rocks. Use mirrors to create an optical illusion. Make a decoy cave.
Solution considered – Use mirrors to create an optical illusion.
Consequences – Mirrors may be hard to make from mica. Sun may not be shining. Mirrors can be easily seen. May take a long time to set-up.
Value - The cave will be found and we will be caught.
New solution – Decoy camp by setting it up elsewhere and post guards to warn of approach to cave.

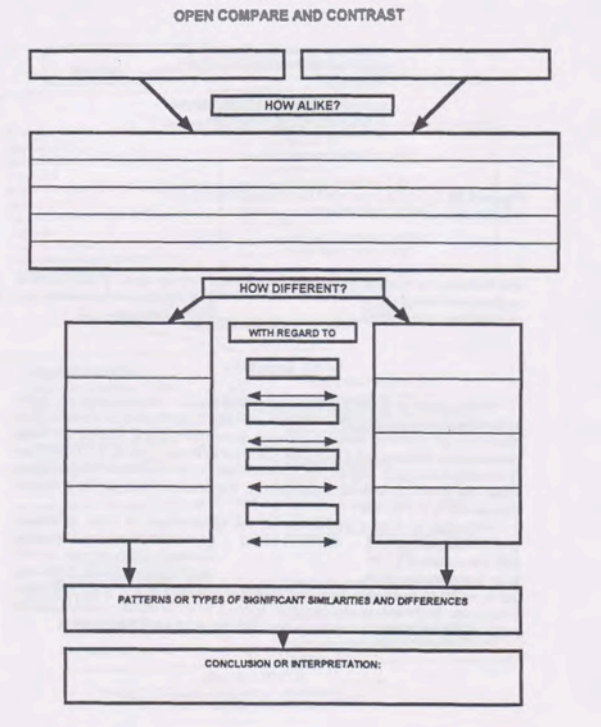
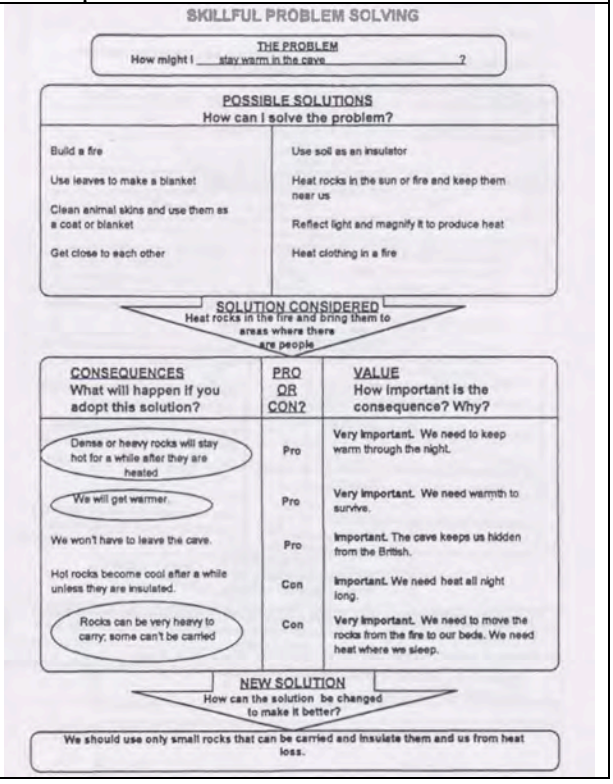
The problem – How might we use the rocks to help us survive?
Possible solutions – Use graphite to communicate. Use rock like pyrite to create a trap. Use mica to keep us warm. Use rocks with sharp edges as weapons.
Solution considered – Use mica to keep warm.
Consequences – Would need to find a lot of mica. It would take some work to get it into the cave. It crumbles easily. It is a good insulator. It would keep the bed clean. It would keep you warm.
New solution – Break up mica and place inside the bed roll for comfort and warmth.

Appendix C. Metacognition Strategy

Stage	Metacognitive Level	Teacher Poses Such Questions as…
4	PLANNING ahead for future thinking	How might you do it next time? As you anticipate similar problems in the future, what insights might you carry forth? When else in (this course) (school) (life) (work) might this strategy prove useful? By what criteria will you judge that this is the best way to approach this problem? Why is it important to you to……?
3	EVALUATING the effectiveness of the strategy--before, during and after.	How well did your strategy work for you? "How do you know your strategy is working? What corrections, alterations in your strategy are you making as you…..? What will you pay attention to while you are solving this problem to let you know your strategy is working? What alternative strategies might you I employ if you find your strategy is not working Why do you think this is the best strategy? What has worked for you in the past? What makes you think that strategy will work in this situation?
2	Knowing the STRATEGY you are going to use/are using as you do the thinking.	What am I going to use? What approaches might you employ…? As you approach this problem, what metacognitive strategies will you employ…? As you consider the steps in problem solving process, where are you……? What patterns are you noticing in these approaches to solving these problems? As you reflect on your problem solving strategy,…….? What led you to this decision to…….?
1	Being AWARE of the kind of thinking you are doing.	Describe the work you are doing. How did you go about doing it? What was going on in your head when….? What were you thinking when……? What were you aware of while…? What questions are you asking yourself? While you were solving this problem, what mental processes were you using when….?

Appendix D. Verbal Maps and Associated Thinking Maps

Compare and Contrast Verbal Map Source: Swartz & Parks, 1994, p. 102	Problem Solving Verbal Map Source: Swartz & Parks, 1994, p. 78
1. How are the similar? 2. How are they different? 3. What similarities and differences seem significant? 4. What categories or patterns do you see in the significant similarities and differences? 5. What interpretation or conclusion is suggested by the significant similarities and differences?	1. What is the problem? 2. Why is there a problem? 3. What are possible solutions to the problem? 4. What would happen if you solved the problem in each of these ways? 5. What is the best solution to the problem?

Open Compare and Contrast: Thinking Map Source: Swartz & Parks, 1994, p. 103	Example of One Problem Solving Thinking Map on Sub Problem: How will we get heat to keep us warm?
	

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The Current Middle School Movement in Tennessee: Surging or Staggering?

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Abstract

This descriptive study sought to determine the attitudes of middle school teachers in Tennessee toward the current implementation levels of key components of the middle school concept within their schools. Participants were selected randomly from a population list of districts. Sixty four teachers out of 150 (43%) completed questionnaires. Results found that many essential components of effective middle school programs are currently present in the schools, with only a few tenets perceived to be disappearing or absent completely. Teachers, however, believed they have less autonomy. Most reported a decrease in the amount of enrichment, elective or exploratory courses and activities. In total, the results from this statewide study suggested that teachers consider the middle school concept to be relevant, visible, and applicable. The real issue would appear to be the intensity, integrity, and consistency with which the components are actually practiced.

There can be little dispute that the middle school concept has been placed on the defensive over the past few years. With many districts nationwide shifting to traditional K-8 alignments (Yecke, 2006) or contemplating a return to a junior high orientation (Cafazzo, 2007; Lenz, 2010) the familiar charge that middle schools sacrifice academic responsibility in their overambitious effort to address the nature and needs of young adolescents continues to be heard. According to the *Rand Report*, the middle school is characterized by troubling social climates, behavioral problems, low achievement, and teachers who lack middle school-specific expertise (Juvonen, Le, Kaganoff, Augustine, & Constant, 2004). Yecke (2005), author of *Mayhem in the Middle: How Middle Schools Have Failed America and How to Make Them Work*, argued that partisans of the middle school concept are fixated on non-academic goals and concerns such as self-esteem, mental health, identity development, interpersonal relations, egalitarian principles, and social justice. Chadbourne (2003), however, found support for these criticisms to be based largely on impressionistic and circumstantial evidence.

Lounsbury (2009) insisted the general public's perception that the middle school has been a failure is the result of the inability or unwillingness to recognize the difference between the "middle school concept" and "the middle school" as it is commonly practiced. In other words, the middle school concept's components are sound but have not been well implemented over time and rarely as a complete set of principles and practices (Beane & Lipka, 2006). Such discord would seem to be problematical not only for students and the manner by which they learn, but

for pre-service teachers now preparing to guide our middle grades classrooms. Will the core principles of middle school education as defined in *This We Believe: Successful Schools for Young Adolescents* (National Middle School Association, 2003) and *Turning Points: Preparing American Youth for the 21st Century* (Carnegie Corporation, 1989) be manifested in the buildings they enter--- or, will they immediately encounter an inconsistency between their middle school preparation program and the realities of various districts in which they seek employment?

In 2007 long-time middle school advocate Paul George conducted a survey of middle school principals and district directors of education throughout the state of Florida regarding the current implementation of key components of the middle school concept within their respective middle schools. George concluded that essential elements of the middle school model were disappearing from the daily experiences of teachers and students. George called for a replication of his study in other states to help determine if the trends he captured within Florida are, in fact, pervasive or merely characteristic of a distinct geographic location. I acted upon George's recommendation for future research by exploring initially the states of Indiana, Kentucky, and Ohio, yet modified the focus by examining the perceptions of middle school *teachers* who, according to early advocates Wiles and Bondi (1981), truly hold the key to the realization of the type of middle school required for emerging adolescents. The National Middle School Association likewise insisted that teachers have the single greatest impact on student learning (National Middle School Association, 2003).

This study sought to further expand that inquiry by determining the extent to which middle school teachers throughout Tennessee believe the central elements of the middle school model are presently implemented within their buildings. The study was also seeking to underscore both the factors that allow the middle school concept to thrive and factors that hinder its growth. In short, what assumptions can be made about the current state and relevancy of the middle school movement in Tennessee?

Between 1991 and 2003, more than 3,700 studies related to middle schools were published (Hough, 2003), yet there has been a scarcity of attention paid to the actual *implementation levels* of middle school tenets in various schools and districts across the United States. When considering more recent studies, the aforementioned work conducted in Florida by Paul George (2007) is certainly notable. Using survey data from 33% of middle school principals and district directors of secondary education, George found interdisciplinary team organization, advisory programs, curriculum enrichment and exploratory programs, flexible scheduling, heterogeneous grouping, and intramurals to be offered less frequently than in past years. Respondents identified testing and accountability measures as the primary reason for this decline.

Conversely, three key components, all considered highly desirable for the education of young adolescents, were reported as being implemented widely in Florida schools. Eighty-eight percent of the principals and directors of education reported a shared decision-making model involving school and team leaders, along with other faculty representatives, to be presently implemented fully. Eighty-four percent of respondents indicated that active learning strategies, based on the learning styles of young adolescents were either implemented fully, or present (even if less so than in prior years). Seventy-two percent of respondents signified that teachers in their middle level schools were selected on the basis of certification, interest and skill in working with young adolescents.

Roney, Brown, and Anfara (2004) found little difference between the various types of middle school reform in high-performing schools (HPS) and low-performing schools (LPS) throughout the Philadelphia metropolitan area. Overall results indicated a 73% rate of implementation in both types of schools. However, findings also illustrated differences between the degrees to which middle level reform is implemented at the various schools. It is concluded that factors other than the reforms themselves contribute to these discrepancies.

Faulkner and Cook (2006) used the Middle School Concept Implementation Survey (MSCIS) to examine the realization of the middle school concept, the instructional practices of middle level teachers, and the influence of state assessment on those practices within 17 middle schools in six northern Kentucky counties. The survey items were derived from, and aligned with, the eight cultures and six programmatic characteristics of effective middle schools proposed in *This We Believe*. The online survey garnered a 26.8% response rate. Based on overall averages of the eight cultures identified, teachers' perceptions on the implementation of the middle school concept were positive, with all categories receiving an average score of at least 2.67 or higher on a 4.0 scale, indicating a perception of successful implementation in all eight culture areas.

High expectations for every member of the learning community (3.16), a shared vision that guides decisions (3.15), and educators who value working with this age group (3.12) received the highest overall averages. Additionally, students and teachers engaged in active learning (3.04), courageous, collaborative leadership (2.99), and an inviting, supportive, and safe environment (2.99) received a moderate level of perceived implementation. School-initiated family and community partnerships (2.87) and an adult advocate for every student (2.67) were perceived to be the two weakest areas of implementation.

Cook, Faulkner, and Kinne (2009) investigated the perceived level of implementation of key tenets of the middle school concept as outlined by *This We Believe* in schools designated as Kentucky Schools to Watch (middle schools described as "high performing" based on criteria by the National Forum to Accelerate Middle Grades Reform) as compared to non-designated schools. Additionally, the study reviewed the academic performance of Kentucky's middle schools on the Kentucky Core Content Test to determine whether the schools identified as Kentucky Schools to Watch experienced higher levels of student academic achievement. Results indicated a slightly higher perceived level of implementation of key tenets of the middle school concept in Kentucky's Schools to Watch and revealed overall higher levels of academic achievement as measured by the Kentucky Core Content Test.

As pointed out, empirical studies examining exclusively the implementation of the middle school philosophy within individual schools are sporadic at best. The limited existing literature *suggests* a generally favorable level of implementation, but more data are needed in diverse locations to determine if meaningful patterns are truly discernible.

Method

This study utilized the survey instrument created by Paul George and adapted by this author for the teachers within Tennessee. Part one of the survey asked respondents to assess the current level of implementation of key components of the middle school concept (National Middle School association, 2003) within their respective building. Respondents estimated whether the component was "currently implemented fully," "implemented now but less fully than in prior years," "implemented in the past but not currently," or "never implemented." Part two invited additional reflections about various aspects of middle school programs in the district.

Using a list generated by the Tennessee Department of Education, the names of 303 middle schools throughout the state were obtained. While recognizing that schools of various grade configurations and names may, in actuality, incorporate many of the key middle school components pertinent to this study, it was believed that teachers in so-named middle schools would be more likely than K-8 or junior high school teachers to be familiar with and thus able to identify specific tenets from the National Middle School Association, including its mission and goals. Simple random sampling was then employed to select 150 middle schools (approximately half of the state total). The teaching staff roster for each of the designated schools was compiled and a number assigned to each teacher. If a chosen school did not have teacher contact information available on its homepage, the school was withdrawn and another chosen randomly. The random function of Excel was then utilized to select 150 teachers (a figure thought to be illustrative, yet manageable) from the master population list who ultimately received the questionnaire.

Results

Sixty-four teachers responded to the questionnaire, producing a return rate of 43%. A balance of rural, suburban, and urban school districts from the 10 field service regions throughout Tennessee was present within the final sample (43% rural, 33% suburban, and 24% urban). Table 1 provides an overview of the organizational structures represented by the teachers in the sample; Table 2 depicts the current enrollments in the schools, while Table 3 portrays the type of certification or licensure held by the respondents.

Table 1
Organizational Structures

Grade Levels	Number of Teachers	Percent Responding
Grades 6-8	52	82%
Grades 7-8	0	0%
Grades 5-8	12	18%
Grades 5-6	0	0%

n=64

Table 2
Current School Enrollment

Range	Number of Teachers	Percent Responding
250 or less	4	6%
250-500	12	19%
500-750	23	36%
More than 750	25	39%

n=64

Table 3
Type of Certification or Licensure Held

Teaching Level	Number of Teachers	Percent Responding
Elementary and Middle Grades	40	62%
Middle Grades Only	11	17%
Secondary and Middle Grades	13	21%

n=64

Table 4 reveals that teachers in the study identified several components of the middle school concept that are currently implemented fully in their buildings. The highest total for a current and full implementation of a middle school construct (84%) came in response to the presence of an after-school extra-curriculum program. Next, 81% of respondents believed that teachers in their building are chosen on the basis of their certification, interest, and skill with young adolescents as opposed to merely their content area knowledge. Seventy five percent of teachers expressed that the use of interdisciplinary teams was at a high level of implementation, while 70% of participants perceived active learning strategies centered on the learning styles of young adolescents to be at full implementation, along with a curriculum that provides a broad range of exploratory opportunities. Other tenets that exceeded the 50% mark included building facilities designed especially for middle school students (59%); staff development and program renewal focused on young adolescents (56%); and a regular, systematic faculty/administrator shared decision-making model (52%).

Also revealed in Table 4 are those components where "never been implemented" was the option expressed by a majority of respondents, although few of the percentages were excessively high. Sixty six percent of the teachers stated that organizational arrangements encouraging long-term teacher-student relationships (looping, multiage grouping, school-within-school, multi-year houses) were largely absent. The next highest totals involved a long block schedule of no more than five periods per day (45%); special interest activities programs emphasizing student and teacher choices (44%); and comprehensive transition programs for entering sixth graders and rising eight graders (44%).

In addition, Table 5 suggests that funding was the primary reason for the current lack of fully implemented middle school components within the respondents' schools, although none of the options reached 50%. Twelve teachers supplied written comments to accompany their ratings for this particular question and, interestingly, all 12 comments singled out school leadership as playing a role in the school's lack of fidelity to the middle school model. Eight respondents cited "administrative indifference," while one teacher expressed, "The only lessons allowed to be taught must come from the state objectives list. No attention is paid to student interests."

Table 4
Current Levels of Implementation of Middle School Components within Schools

Middle School Component	Never implemented	Implemented in past but not currently	Implemented now but less fully than prior Years	Currently fully implemented
After school extra-curriculum program	4 (6%)	1 (2%)	5 (8%)	54 (84%)
Teachers chosen on the basis of their certification, interest, skill with young adolescents	3 (5%)	6 (9%)	3 (5%)	52 (81%)
Interdisciplinary team organization	0 (0%)	9 (14%)	7 (11%)	48 (75%)
Active learning strategies	3 (5%)	1 (2%)	15 (23%)	45 (70%)
Exploratory opportunities	5 (8%)	5 (8%)	9 (14%)	45 (70%)
Building facilities designed for middle school students	17 (27%)	3 (5%)	6 (9%)	38 (59%)
Staff development and program renewal focused on young adolescents	9 (14%)	7 (11%)	12 (19%)	36 (56%)
Regular, systematic faculty/administrator shared decision-making model	8 (13%)	8 (13%)	15 (23%)	33 (52%)
Heterogeneous grouping	3 (5%)	10 (16%)	20 (31%)	31 (48%)
Long block schedule of no more than five periods/day	29 (45%)	3 (5%)	1 (2%)	31 (48%)
Teacher-based guidance, advisory, or mentoring program	18 (28%)	7 (11%)	13 (20%)	26 (41%)
Special interest activities program emphasizing student and teacher choice	28 (44%)	8 (13%)	5 (8%)	23 (36%)
Comprehensive transition programs for sixth graders and rising eighth graders	28 (44%)	5 (8%)	9 (14%)	22 (34%)
Flexible scheduling controlled in part by teams	25 (39%)	12 (18%)	10 (16%)	17 (27%)
Organizational arrangements encouraging long-term teacher/student relationships	42 (66%)	10 (16%)	6 (9%)	6 (9%)

n=64
Note: All percentages have been rounded upward when appropriate.

Table 5
Teachers' Explanation for Decline in Components Implemented Currently

	Number of Teachers	Percent Responding
Funding	20	32%
Lack of fit with state testing/accountability	18	27%
Faculty opposition	15	23%
Central office opposition	11	18%
Lack of parent/community support	0	0%

n=64

Table 6 reveals the components teachers selected as the most likely explanation for their schools' ability to maintain the components of the middle school program they believed are presently implemented. Faculty buy-in was noted by 50% of the participants.

Table 6
Teachers' Explanation for Schools' Ability to Maintain Components Implemented Currently

	Number of teachers	Percent responding
Faculty buy-in	32	50%
Success with state testing/accountability	20	31%
Central office support	9	14%
Parent/community support	3	5%
Funding	0	0%

n=64

Teachers were asked to consider curriculum changes at their schools. Seventy one percent reported seeing additional core courses, remediation, and pullout/tutoring courses. Fifteen percent perceived additional enrichment, elective or exploratory courses and activities; while 14% expressed that no substantial changes have been made.

One hundred percent of the teachers believed that their district will continue to organize the middle level as is and do not believe their district intends to configure K-8 schools in the future. Ninety one percent of the teachers would not favor the middle grades being included in an elementary building. When asked for the last time their faculty, as a unit, was involved in professional development dealing with the characteristics and needs of young adolescents, 39% indicated it occurred "within the last 6 months" while 9% believed it happened "more than a year ago." Thirteen percent of teachers said they "do not recollect any such training." Finally, the survey asked teachers to consider their autonomy and freedom as a classroom teacher (i.e. the freedom to make choices about the program of your school without interference from central office), and indicate if they believe they have more or less autonomy and freedom than in prior years. Seventy seven percent felt they currently have less autonomy.

Discussion

Components Consistent with Middle School Model

The components reported by Tennessee teachers to be at the highest levels of implementation are all integral to meeting the essential attributes of young adolescent education as articulated in *This We Believe*: developmentally responsive, challenging, empowering, and equitable (National Middle School Association, 2003). For example, the structured time provided by after school extracurricular programs is related to a pattern of less risky behavior in middle school students (Simpkins, Fredericks, Davis-Keen, & Eccles, 2006) and influences positive social-emotional development and school adjustment (Ripke, Huston, & Casey, 2006). Choosing teachers on the basis of their certification and skill with young adolescents is consistent with the National Middle School Association's argument that educators in middle level schools need preparation and training specific to those grades, and that distinctive middle grades licensure should be mandatory in all states (National Middle School Association, 2003). The practice of staffing middle level schools with teachers and other professional personnel who lack special preparation for working with young adolescents has been a perennial roadblock to excellence in middle level education. A faculty of middle school specialists, passionate and determined about how pre-adolescents think and learn, is indeed fundamental because teachers' prior beliefs and values are important influences on their practice, especially when it comes to influencing how receptive teachers are to ideas they might encounter from research or colleagues. If teachers are sympathetic with a reform agenda, they will be receptive to its research findings, but if they are not sympathetic, they will probably not be persuaded by the research no matter how authoritative or relevant it might be (Kennedy, 1997).

Interdisciplinary team organization, another component reported at high levels of implementation, is heavily supported in the seminal middle grades literature and consistently identified as perhaps the most significant contribution of the middle school movement to the education of pre-teenagers and early teens (Flowers, Mertens, Mulhall, & Crawczyk, 2007). Interdisciplinary teaming is certainly in harmony with the structure outlined in *This We Believe* and *Turning Points* inasmuch as both documents advocate organizational structures that support meaningful relationships and a shared vision that guides decisions. Jackson and Davis (2000) insisted that "teams provide the essential mechanism for translating academic standards into engaging, interdisciplinary learning activities and assessment strategies that help adolescents realize their full learning potential" (p. 128). Arguments have been advanced, however, that, for many schools, teaming is solely a matter of organization rather than function. With limited team planning and minimal integration of curriculum, teachers have, in fact, implemented "teams" but not necessarily "teaming" (Faulkner & Cook, 2006). For this reason, it is difficult to surmise if 75% of respondents in the survey are truly making such a distinction.

Teachers reporting full implementation of active learning strategies underscore the belief that most middle level students require ongoing, concrete, experiential learning in order to develop intellectually (National Middle School Association, 2003). Likewise, when teachers describe their buildings as facilities designed especially for young adolescents, they speak to a concern that the physical learning environment prevalent in elementary and high school buildings does not always coincide with the peculiar needs and interests of adolescent youngsters. Ideally, a middle school facility should be relatively compact and further broken down into cluster areas so that each student belongs to an area of the school that is smaller than the whole, but larger than the classroom. *Turning Points* (1989) considers dividing large middle schools into smaller learning communities to be one of its eight essential principles.

Components Inconsistent with Middle School Model

Data from Tennessee middle school teachers did not uncover any widespread lapses in the implementation of key middle school components. As noted, only organizational arrangements that encourage long-term teacher-student relationships were singled out by greater than 50% of participants. Of all the elements of the middle school concept to be absent, this tenet is perhaps the least unexpected. In Daniel's (2007) *NMSA Research Summary on Multiage Grouping*, he reported only meager research on this topic, due in large part to the relative infrequency of the practices. George and Lounsbury (2000), authors of *Making Big Schools Feel Small*, advocated for smallness through the development of long-term relationships, multi-age instruction, and schools-within-schools concepts, yet likewise noted that research on strategies such as looping at the middle level is lacking because the practice itself is limited in scope and execution. Thus, Tennessee is not alone in reporting a scarcity of such organizational arrangements. Paul George, for example, found strategies that lengthen the time teachers and students stay together to be "largely absent from Florida middle schools" (p.3).

Transition programs for both sixth and eighth graders, special interest activities, and flexible scheduling were other components registering somewhat high percentages of non-implementation. Especially in the case of flexible scheduling, such findings are not necessarily peculiar to the state of Tennessee. Daniel (2007) conceded that middle school advocates for several decades have promoted flexible scheduling (including block scheduling), but middle grades schools have been slow to jettison the traditional fixed-period day. The rationale behind flexible scheduling remains the opportunity for students to experience more time for engagement with a variety of learning strategies. George discovered block scheduling to be nonexistent in 92% of Florida middle schools.

Implications and Recommendations

Although data in specific categories were very similar to numbers generated in Florida, Indiana, Kentucky, and Ohio, the middle school model actually appears to be implemented more consistently in Tennessee than the aforementioned states. In order to continue with a high level of efficiency, several recommendations seem appropriate. First, teacher education programs need to ensure they are assigning pre-service candidates to field placements with administrators and supervising teachers who embrace the middle school philosophy. To do otherwise, is to perpetuate misuse or underemployment of effective strategies and techniques, leading to ignored or poorly implemented middle school components (Pilcher & Boyce, 2005).

Providing professional development for current middle school administrators and teachers is also paramount, especially in those areas where lower rates of implementation are apparent. Professional development efforts need to be hands-on and targeted to identifiable, directed classroom applications because changing practice does not generally occur by simply *informing* principals or faculty. In such instances, research is more likely to be used conceptually rather than instrumentally (Kennedy, 1983). It was discovered, for example, that teachers do not always *adopt* innovations, but instead *adapt* them (Berman & McLaughlin, 1978). This study served to isolate areas of concern, while simultaneously articulating the components, which appear to be implemented in most schools in a satisfactory manner. As a result, cherished professional development time can strengthen those areas where middle school teachers believe the middle school concept has experienced decline rather than in continually revisiting those tenets where concurrence is already demonstrated. In the case of Tennessee

middle schools, an examination of organizational arrangements that encourage long-term teacher/student relationships would be advantageous.

Limitations of the Study

This study recognized the inherent limitations of self-report survey research, namely the inability of such data to establish cause-and-effect. Likewise, the extent to which the components are implemented with full integrity and compliance to *This We Believe* and *Turning Points* is not possible to ascertain from the data.

Sampling in this study considered only public schools identified in name as "middle schools" and did not include middle grades configurations in elementary buildings or schools referred to as "junior high schools." Teachers who received the questionnaires were restricted to those who taught in schools for which contact information was available at a school website. Also, because rosters from 150 middle schools were compiled in the original population, sampling error may have occurred in that some schools may not have been represented at all and others may have had more than one teacher in the building receive the questionnaire. While this study utilized a sufficient sample, the ability of the sample to generalize to other teachers and middle schools throughout Tennessee should not be overstated.

Future Research Needed

When Paul George called for replication of his 2007 work he acknowledged that the middle school philosophy is followed with greater integrity in certain regions and geographic districts than in others. For this reason, the research he initiated and the data I have likewise collected still calls for further extension. Expanding this study into other sections of the country, along with increased sample sizes, would serve to capture the attitudes of more and more teachers, thereby helping to determine if independent investigators, in fact, detect similar outcomes. A qualitative endeavor in the form of an interview study is likewise suggested to focus on the in-depth perceptions of teachers and allow for elaboration as to the reasons why certain middle school components are either not in place at all or have not been implemented vigorously.

Conclusions

Middle school proponents, especially those within Tennessee, should be energized from this study inasmuch as the data suggest key components of the middle school philosophy are quite visible throughout the state. Granted, it is not within the scope of this study to make a determination if reported practices in classrooms and buildings are sufficiently implemented as originally conceived. One must also be aware that, while many percentages of full and current implementation were reasonably high, they were not 100% and several tenets were well below 50%. Professional development must be intensive and continually emphasize that the middle school model is a coherent "package" built around student engagement, improved relationships between teachers and students, small collaborative teaching teams, and an integrated curriculum. The characteristics are interdependent and must be implemented in concert (National Middle School Association, 2003). Proponents within the middle school movement must concede that some districts have been either unwilling or unable to execute various elements of the philosophy, and many of those elements appear to be consistent across several states. The "pick and choose" mentality is, to some degree, the scourge of the middle school movement because the model was never intended to be viewed as a collection of disparate elements from which individual middle schools "make their own sundae." For this reason, Tennessee should continue its efforts to educate administrators, teachers, and the public about the middle school concept and continue to prepare and hire teachers (and

administrators) that will have specialized knowledge about adolescents and pre-adolescents and the way they learn. Tennessee can be proud of its progress to date and can use this encouraging data to lead the way for other states in recognizing the need for developmentally appropriate teaching methods and strategies that enhance teacher efficacy. In that way, the notion that middle school is an "idea" and middle school students are "unique" could finally be on the cusp of realization.

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MEMBER APPLICATION/RENEWAL

Individual Membership: $20
Student/Parent/Retiree: $10 (Full-time students, retired educators, non-educator parents)
School Group Memberships: 20 or more memberships from the same site, accompanied by individual membership forms and one check covering all memberships: **$12 per educator**

Date_____ Renewal_____ or New_____

Name_____

Mailing Address_____

City_____State_____Zip_____-_____

Phone: Business (____) _____ Home (_____) _____

Email: Business _____ Home _____

School_____System_____

Position Held: (circle one) Teacher Principal Asst. Principal Counselor
Supervisor/Coordinator Librarian College/University Retiree
Non-educator Parent Consultant Full time Student

TYPE OF MEMBERSHIP

Individual_____ $20_____

Group Rate (20 or more from one site)_____ $12 each_____

Student_____Retiree_____ Non-Educator Parent_____ $10_____

Send check payable to TAMS to above address Total amount of check_____