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PESLAU: Rx for Increasing Physical Activity in Tennessee Middle Schools by Allen H. Seeds, Assistant Professor and Ben Dyson, Associate Professor, University of Memphis

On a relatively warm October afternoon, Ms. G's sixth grade students are not sitting at their desks inside the classroom, instead they are outside playing "Predators and Prey." Most students, role playing rabbits, are running away from the smaller number of student foxes. Later, when they return to her room somewhat disheveled and sweaty, Ms. G says enthusiastically, "You'll need your folders for class today." The students open their desks or move to their shelves to obtain brightly decorated folders containing task sheets for today's lesson. One folder catches the observer's eye: written in boldly colored letters and symbols is "I ♥PESLAU" across the folder's cover.

Introduction

According to the American Heart Association (2007), Tennessee ranks third in childhood obesity out of the 50 United States. To stem the rise in young adolescent obesity, middle level educators are being urged to provide more physical activity (Black, 2004). Recent Tennessee legislation dealt with this concern by requiring all middle schools to provide 90 minutes of physical activity per week. The Carnegie Council on Adolescent Development (1995) also asks middle level educators to provide students with a curriculum that emphasizes connections between disciplines. PESLAU, an acronym for Physical Education, Science, and Language Arts Unit meets both needs effectively.

While it is relatively rare to find physical education incorporated in middle school interdisciplinary units, it has been done and is not difficult to do, with a little imagination. Buchanan, Martin, Childress, Howard, Williams, Bedsole, and Ferry (2002) describe a unit entitled "Fit Newton's Great Adventure" successfully implemented in a rural elementary school's fifth grade. This unit focused on integrating physical education and science through project adventure type activities encompassing critical-thinking tasks, problem-solving tasks, cooperative learning, and journal writing.

Interdisciplinary units provide a focus for learning, assist students in understanding what and why they are doing things, illuminate content connections, allow transfer of learning from one context to another, and promote knowledge acquisition (Ritter, 1999). Using national standards, Satchwell and Loepp (2002) developed 6th, 7th, and 8th grade interdisciplinary units called IMaST that integrated Mathematics, Science, and Technology. Students and teachers use the four phase IMaST learning cycle during the units. The cycles are: *Exploring the Idea, Getting the Idea, Applying the Idea,* and *Expanding the Idea*. In phase one of the cycle, students engage in open-ended and hands-on activities facilitated by the instructor. These activities require students to work cooperatively while investigating the problem, solving the problem creatively, testing a variety of ideas, and recording the results. In phase two, the instructor leads discussions, answers questions, and encourages whole-class reflection. The teacher also provides feedback to students on their work and ideas. During phase three, students explore the concepts they are learning in a variety of new contexts and examine how their new-found knowledge applies to other disciplines. The final part of this cycle allows students to make connections to the world outside of the classroom.

Unit Development

Two teachers and three professors, including one of the authors, found a mutual interest in active learning and decided to co-construct our own interdisciplinary unit. Using foundations similar to the previously described interdisciplinary units, we developed PESLAU to integrate Physical Education, Science, and Language Arts in the middle grades. I and another professor began the process by developing a framework of lessons that focused on the science topic of electric circuits. Almost immediately, we identified the physical activity entitled "The Human Knot" as a way to physically illustrate electric circuits. Meanwhile, our reading specialist was adapting the cooperative learning activity known as Literature Circles (Daniels, 2002) for science class. The result: Science Circles. When we presented our work to the physical education teacher and a sixth grade teacher; they quickly threw out some pieces of our plans and added more relevant school based material that would work with their students, resulting in a much improved product.

To begin the unit, students were introduced to several physical activities that could be related to the science topic in the physical education class. For the lesson sequence in science class, students were split into groups of five students forming a Science Circle, a cooperative learning instructional format. Each student was given a specific role to fulfill: *activity director/recorder*, *taskmaster/coach*, *word wizard*, *summarizer/reflector*, or *illuminator/demonstrator*. The *activity director/recorder* was to develop a minimum of five questions about their topic to discuss. The *taskmaster/coach* needed to identify at least three things about the topic that the group would reread, discuss, or think about including important ideas about the topic, surprising, or controversial. The *word wizard* located terms in the readings that were important or new. They then wrote the sentence the word was found in, its definition; and an "excellent sentence" of their own containing the term. The *summarizer/reflector* explained the main ideas and key points of the topic in a summary. They would read their summary aloud and discuss it with their group members to bring closure to each lesson. The *illuminator/demonstrator* used his or her artistic skills to draw pictures, cartoons, charts or diagrams pertaining to the topic. All group members had to design a physical activity that illustrated the science concept to be presented in the next physical education class.

Most importantly, physical activity was not confined to the physical education class. Games such as "Predators and Prey" and other physical activities became a regular part of the regular classroom. We worked together to identify, modify, or develop appropriate activities. One of our most useful resources was the set of activities we received from a Project Adventure workshop.

Benefits

What were the benefits of PESLAU (Physical Education, Science, and Language Arts Units)? According to the students, they learned concepts better as a result of participating in the unit. James said, "It helps us learn better because when we are in our class and we [are] doing language we have a song with our language that instead of just raising our hand and telling Ms.G. things, we do our songs, play our games as we are doing our language tasks. I really like that we have PESLAU."

Brie expressed that her physical activity increased, "I learned new stuff that I have never done before so I sort of practiced it at home." Lisa inserted, "Yes it [physical activity] did [increase] because most of the time it was just boring just sitting there just listening to what she had to say but now we are getting up doing dancing doing movements and then being really creative with our bodies and minds." Barry thought PESLAU made learning more fun, "like when we make body movements and stuff."

The teachers stated that the benefits were numerous. Ms. C. said,

> PE [physical education] helps academically in lots of different ways; it helps with reading and their fine motor skills. But, I always look for some other way that PE helps emphasize some other part of the academics, … truly a way to relate back to the classroom. And I always try that, but I haven't done a lot with science, especially with these kind of concepts. I do it with the body and the different systems of the body and stuff like that, but putting the idea of waves and using PE equipment to do that, or circuits, I think it helps them understand it better. You know understand that idea or concept because some kids have to have hands on to be able to do something. If I do it, I understand it better. You know I can read it in a book, but if I do it, it makes it easier."

Ms. G. spoke about numerous benefits of the unit; including increased enthusiasm, responsibility, and understanding.

> The kids were pretty excited about the unit. … I never did hear anyone complain about what they were doing. Overall attitude was good. Skill level, I think was better. Each child had their own task to complete each day. That made them work harder at completing the task and making sure it was right. They really focused on how well they did the task because no one else was going to do it for them. Cognitively, my students are all very different learners. Some students are very well written and others have difficulty expressing themselves. When I watched them in PE or out on the grass outside my door, I was really impressed. I was thinking 'Wow, they totally do get it!' They really did understand the science concepts, the way they created their body movements. This was really cool for me. This was really good for the Multiple Intelligences. Personal responsibility was excellent for them. In fact, I plan on using individual tasks from now on. That's one thing that I've never really included on a regular basis before during cooperative groups. I've given groups one task before, but giving the individual tasks in the groups makes all the difference in the world as far as personal responsibility.

Concerns

What were some concerns raised about the implementation of PESLAU? Martha was confused by the combining of subjects, "… it was sort of confusing combining reading, PE, and Science all together. Because the *Julia of the Wolves* book, we do activities about it in Science, and then we tie what we did in Science in PE and tie what we did in PE into *Julia of the Wolves* and it all got just so confusing."

Ms. C. had two concerns about implementation. She mentioned a limited list of activities first, "The only thing would be a wider variety of activities to choose from.

Because when we did some of the concepts we just had one activity that we did or maybe two. Even with electromagnetism we just had the pendulum. If we just had more it would be better." Her second concern was a lack of time, "There wasn't enough time. I think we needed more than 30 minutes [in physical education class.] Because when you got into some of the activities you found out that you needed more time to help them understand it or to give them a chance to try."

Advice

MS. C. offers the following advice to those interested in trying a unit like PESALU,

> This is a way to integrate Science, and Language Arts: the science concepts and the writing skills with your PE activities so that, it … all meshes together... It shows that they [the subject areas] complement each other. It is something where they have to have support and responsibility for their learning. It is not just you feeding it to them and them regurgitating it back. You are actually seeing if they understand it. They work in small groups where they are cooperating together. It teaches them social skills. They have to get along. They have to understand that everybody has the right to make a comment; everybody has the right to their own opinion. But, you have the right to disagree, too.

Ms. G. mentioned that she thought it was important to vary the lesson sequence,

> One thing that I might do differently is to mix up activities for each concept. I would keep day one the literacy circle but, after that I would change activities so that each science concept did not follow the same old routine. I thought they would like the routine because the students like when they know what to do. But some of the students came to me and told me that it was getting old.

She also stated that collaboration and planning were crucial to the unit's success.

> Plan, plan, plan: definitely do an introductory lesson on group processing. The children need a lesson on what is group processing, how to work together, and what is personal responsibility. Make sure you throw in good hands-on experiments with the language arts and PE. Don't let the PE experiences make up for hands-on activities in the classroom to go along with the body movements they are doing in PE. You've also got to be open-minded. Let the students do their thing. When it came time to demonstrate their concept, they had it.

The teachers developed a "cheat sheet" for the physical education teacher that explained the science concepts being taught. This was useful in her lesson planning and during class sessions where students were conducting the physical activities they had developed to illustrate the science concepts. Ms. G. explains:

> Well, you'll help each other out. For example, in PESLAU II we were doing animal diversity and we all created T squared, the Tile Toss, which of course combined what we were talking about in PE, throwing and catching, with the scientific names of all of the different animal families, which is really cool because my kids can spell platyhelmenthese and

> nematode and they'll tell you every single animal that goes in that group…Anyway, so, because I don't expect Diane, to understand, to be able to spell Platyhelmenthes and know what the first law of motion is. So I would make a little cheat sheet for her that would take, maybe, five minutes and I just wrote down definitions, things like that.

Conclusion

There are not enough examples of "true" integration in many middle schools and even less that incorporate physical education and physical activity. While one of our main goals was to increase student physical activity, we also hoped to educate the child in a holistic sense, by placing explicit emphasis on the physical, cognitive, and socio-emotional domains of learning. Student and teacher perspectives of PESALU indicate that the integration of reading, science, and physical education can be exciting, purposeful, and beneficial for all participants. Physical activity was not confined to the gym. Students were regularly involved in movement during science class. Students appeared to make stronger connections to some of the difficult science concepts and were able to express themselves more confidently both verbally and in their written work. Reading and writing were developed and supported through the cooperative learning structure of Science Circles. Finally, students enjoyed participating in PESLAU and, in this semester of work, students demonstrated positive results in academic achievement.

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The Impact of Teacher Certification on Middle School Principals' Concerns About The Middle School Transition By Dr. Mack T. Hines III, Sam Houston State University, Huntsville, TX

Introduction

Children experience many academic and social changes during their years of schooling (Adams, 1993). One of the most critical and challenging transitional experiences is the middle school transition. Most studies have focused on students' and teachers' feelings about the middle school transition. But few, if any, studies have investigated middle school principals' concerns about this crucial issue. If the studies were focused on the principals' concerns, they probably did analyze the extent to which the concerns were related to the certification status of the teachers. That is, the studies did not focus on the possible relationship between the principals' concerns and the faculty and staff's concerns about the transition. As a result, I conducted a study that investigated the possibility of this relationship.

In particular, I wanted to explore two ideas. They were as follows:

1. Do middle school principals have strong concerns about the academic and social characteristics of the middle school transition?
2. Can the middle school principals' concerns be attributed to the concerns of the majority of certified or noncertified teachers in their schools?

The answers could provide middle level educators with insight on how to better overcome their concerns about students' inability to adjust to the first year of middle school.

Inspiration for The Study

Research-Based Inspiration

Vars (1998) stated that 88% of all first year middle school students have problems with adjusting to middle school. Vars added that students entering middle school are frequently exposed to gangs, sexual-related behaviors, drugs, alcohol, and other activities seldom seen in elementary school. He concluded that this change often causes children to continually reevaluate their self-concept and self-esteem.

Hines (2003) stated that many first year middle school students have both positive and negative perceptions about their adjustment to middle school. Brown (1994) indicated that many children have severe difficulties with the mental, physical, and academic adjustments to middle school. A middle school transition study conducted in Gwinnett County, Georgia, showed students having the following concerns: getting to class on time, opening lockers, keeping up with materials, getting through crowded halls, and remembering class schedules (Arowosafe & Irvin, 1992). Teachers stated that students experience other adjustive difficulties such as having more teachers, having less

free time, accepting more responsibility for their own actions, and completing long-range assignments.

Robinson, Gardener, and Hillman (1995) stated that students transitioning from elementary to middle school show extreme signs of stress and a decline in their perceptions of school. Crocket, Peterson, Grabo, Schulenberga, and Ebgate (1993) stated that students' academic drive and performance drastically decline in all subjects, especially mathematics, during the middle school transition.

In conducting cross-sectional and longitudinal middle school studies, Eccles and Midgley (1991) found that students' general self-esteem, self-concept, self-efficacy, and intrinsic motivation were lowest between the spring of the sixth grade elementary year and fall of seventh grade middle school year. They added that students' academic self-concept, ability, and interest in math and English declined after the transition. Adams (1993) added that most children's achievement values, interest in learning, self-esteem, and self-beliefs significantly decrease across the middle school transition. This decline is attributed to the lack of congruence between the developmental levels of beginning middle school students and the curriculum emphasized in middle school. The decline across the middle school transition is so harmful that it often causes students to feel alienated (Mizelle, 1995) and quit school (Kurtzberg, 1993).

In 1983, Harter found that students experience the most significant decrease in intrinsic motivation between grades six and seven, the middle school transitional year. In a study conducted on the correlation between middle school and violence, Nielsen (1999) determined that transition students show violent behaviors during the middle school transition. According to the National Middle School Association (1995), the anxiety attributed to middle school transition contributes to maladjustment to adolescence. The report continued that this relationship causes many students to experience low self-esteem until adulthood.

Practical Need

As a former middle school administrator, I saw many middle first year middle school students fail to adjust to middle school. Most of these students were unable to consistently follow middle school rules and procedures. They also experienced extreme difficulties with learning middle level math and English. As a result, their teachers continually expressed frustrations with reaching these students. In fact, many of my first and second year teachers either resigned from middle level teaching or move to elementary or high schools.

After leaving middle school, I began to research the different factors that could cause teachers to express concerns about the middle school teachers. In 2005, I survey 596 middle school teachers to determine their concerns about the middle school teachers. Like the results from previous research, my findings showed that the teachers were very concerned about the academic and social characteristics of the transition. My findings also revealed a very noteworthy trend: The teachers who held certification in middle school were mainly concerned about the academic dimension of the middle school transition. Examples of their concerns were "Having more homework", "Learning Middle Level English", "Learning middle level mathematics", and "Participating in cooperative Learning Activities".

The noncertified middle school teachers, however, were more concerned about the social transition than were the certified middle school teachers. In particular, they were concerned about "Learning and following middle school rules and procedures", "Opening lockers", "Wearing I.D. Cards", "Making New Friends", and "Learning a new building". Both groups were highly concerned about the new students' abilities to deal with peer pressure. Figure one provides you with visual and numeral insight about these results.

Figure One

2005 Results

Middle Level Teachers' Concerns about the Middle School Transition

Characteristics	Category	Certified Teachers	Noncertified Teachers
Homework	Academic	4.01	2.43
Middle Level English	Academic	4.55	2.67
Middle Level Math	Academic	4.23	2.45
Cooperative Learning	Academic	3.99	2.39
Rules and Procedures	Social	2.01	3.89
Lockers	Social	2.44	4.43
New Friends	Social	2.16	4.66
New Building	Social	2.99	4.13
Dealing with Peer Pressure	Social	4.07	4.44

Explanations of Levels of Concern

1=Not Concerned 2=Not Really Concerned 3=Somewhat Concerned 4=Concerned 5=Very Concerned

After weeks of reflection, I attributed this pattern to the teachers' preservice training. As a university's former director of middle level education, I am very familiar with the curricula for preparing middle school teacher. As such, I can justifiably say that the curricula do prepare teachers for the rigors of middle school teaching. But the curricula do not focus on how to accommodate the middle school transition. As a result, the certified teachers were concerned about how to complete teaching responsibilities that

cause problems for first year middle school students. The noncertified teachers were exposed to the curricula that prepare teachers for middle school teaching. Therefore, they are not concerned about their abilities to fulfill these responsibilities. But most concerns do have some level of concern about the social development of students. As such, these teachers are presumably concerns about the transitional characteristics that will affect the transitional development of first year middle school students.

After sharing this theory with my middle level education colleagues, I began to wonder if the teachers' principals were concerned about the transition. The reason is twofold. First, I knew that if the principal teachers' were concerned about the transition, they would need some assistance with overcoming these concerns. I also knew that the level of assistance would be contingent upon the principals' feelings and concerns about the middle school transition. If the principals weren't concerned about the transition, they would probably fail to see the need to address the issue. If they were concerned about the transition, then they would be more inclined to work with their teachers to address this issue. Consequently, my role would be to present them with the findings of the first study and evaluate their concerns about the transition.

The Study

Procedures

This study involved 33 middle school principals. The principals were from Tennessee (5) North Carolina (2), South Carolina (4), Mississippi (3), Alabama (2), Maryland (3), Idaho (1), Arkansas (3), Georgia (2), South Dakota (3), Virginia (3), and Louisiana (2). With the exception of Idaho, each state consisted of at least one principal with a predominantly certified or noncertified teaching staff. Sixteen principals led schools with predominantly certified middle school teachers. That is, the teachers held middle level teaching certificates. These teachers held either 5-8, 6-8, or 7-8 teaching certificates. The remaining 18 principals led schools with predominantly noncertified middle school teachers. They held either K-8 teaching certificates or 7-12 teaching certificates.

I learned this information after dividing the teacher surveys in accordance to their schools. After realizing these findings, I issued the same survey to the teachers' principals. I didn't inform the principals of the first set of findings. The reason is that I didn't want those results to influence their responses to the survey.

After surveying the principals, I found that their responses were somewhat related to the certification status of their teachers. I found that principals of predominantly certified teaching staffs were mostly concerned about the academic characteristics of the transition. Like their faculty and staff members, these principals were very concerned about new students' abilities to adjust to more homework. They were also concerned about new students' abilities to learn new mathematics. But unlike their teaching staff, the principals were not concerned about students' abilities to learn middle level English. They were also not concerned about new students' abilities to participate in cooperative learning activities. Instead, these principals were very concerned about students' abilities to adjust to more classwork and participate in competitive learning activities.

The principals of the predominantly noncertified teaching staffs were mostly concerned about the social characteristics of the transition. Like their teachers, these principals were very concerned about new students' abilities to learn and follow middle

school rules and procedures. They were also concerned about new students' abilities to open lockers, make new friends, and learn a new building. In addition, these principals were also concerned about new students' abilities to change classes, attend a larger school, and meet teachers' expectations. Like their teachers, both groups of principals were extremely concerned about new students' abilities to deal with peer pressure. Figure two provides visual and numerical insight into these levels of concerns.

Figure Two

2005 Results

Middle Level Principals' Concerns about the Middle School Transition

Characteristics	Category	Principals of Predominantly Certified Staffs	Principals of Predominantly Noncertified Teaching Staffs
Homework	**Academic**	**4.62**	2.13
Middle Level Math	**Academic**	**4.69**	2.42
Classwork	Academic	4.84	2.11
Competitive Learning	Academic	4.02	2.24
Rules and Procedures	**Social**	1.56	**3.24**
Lockers	**Social**	2.32	**4.01**
New Friends	**Social**	2.01	**4.23**
New Building	**Social**	2.82	**4.05**
Change Classes	Social	2.22	4.55
Larger School	Social	2.11	4.62
Teacher Expectations	Social	3.01	4.33
Peer Pressure	**Social**	**4.77**	**4.88**

Explanations of Levels of Concern

1=Not Concerned 2=Not Really Concerned 3=Somewhat Concerned 4=Concerned 5=Very Concerned

Boldfaced = The teachers also had similar concerns about the transitional characteristic.

Conclusions

Implicational Summary

After carefully reflecting on these results, I found that the principals' concerns were similar to the concerns of their faculty and staffs. That is, the principals of certified teaching staffs were very concerned about the academic characteristics of the middle school transition. But they were not that concerned about the social characteristics of the middle school transition. The principals of noncertified teaching staffs were very concerned about the social characteristics of the middle school transition. Like their faculty and staff members, they were not that concerned about the academic characteristics of the middle school transition.

In addition to this conclusion, I also found a few more significant outcomes. A comparison of figures one and two shows that the middle level principals of predominantly certified teaching staffs held higher concerns about the characteristics than did their teachers. These principals were also concerned about academic characteristics that were not of concerned to their teachers. The principals of predominantly noncertified teaching staffs had lower concerns about the social characteristics than did their teachers. These principals were also concerned about several additional social characteristics. These characteristics were not of concern to the principals' teachers.

In my opinion, these findings bear one important implication for middle school principals and teachers. They highlight the need to develop an ongoing dialogue about their concerns about the middle school transition. The principals and teachers of this study and the previous study, respectively, were unaware of each other's concerns about the middle school transition. As a result, they probably struggle with developing strategies to address their concerns. Equally significant, the teachers' concerns could prevent them from effectively helping children with adjusting to middle school. Therefore, I am proposing the use of the following concerns based approach to reduce or eliminate both the teachers' and principals' concerns about the middle school transition.

Concerns Based Approach
Middle School Transition

Step 1: I have provided the principals with the findings from both studies. Prior to beginning the school year, the principals should discuss the findings with their teachers.

Step 2: The principals and the teachers should develop the discussions into a middle school transition plan. The plan should enhance their abilities to help children adjust to middle school.

Step 3: During the school year, the principals and teachers should hold frequent transitional meetings. During these meetings, they should share their successes and troubles with helping children to adjust to middle school. They should depart these information sharing sessions with new strategies for helping the students with achieving the transition.

The benefits of this approach are twofold. First, this approach creates a professional learning community for resolving the transitional problems of middle school students. Second, this approach will help principals to understand that they can also learn from their teachers. Overall, I believe that this approach and study showed that teachers can also influence principals' beliefs about middle level related issues. As such, the principals and teachers should openly communicate about the middle school transition. That way, they can collaboratively close the transitional gap that separates their first year students from the actual adjustment to middle school.

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Math and Science Instruction in the Middle School: Should Teachers Be Concerned? By S. Wali Abdi, Professor of Science Education, The University of Memphis

> Education has no higher purpose than preparing people to lead personally fulfilling and responsible lives. For its part, science education—meaning education in science, mathematics, and technology—should help students to develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and to ….
>
> – *Science for All Americans* (1989, p. 1)

Introduction

The 1995 *Third International Mathematics and Science Study* found that "the U.S. twelfth-graders scored below the international average and among the lowest of the TIMSS nations in mathematics and science general knowledge, as well as in physics and advanced mathematics" (p. 1). *Before It's Too Late* (2000) states that "our students' performance in mathematics and science is unacceptable" (p. 10). This well-written document proposes in the strongest terms that "the time to act is now" (p. 16). Moreover, *The Chronicle of Higher Education* (2000) presented a *Science and Engineering Indicators* report that predicts an enrollment decline in the nation's graduate programs in science and engineering. Based on this report, the National Science Foundation points out that a shortage of skillful workers could have an adverse effect on the national economy.

Persistent reports in the media indicate that students are not performing well on state standardized tests at the end of the school year. As a result, certain schools have been placed on probation or on the state's censured list until students' performance shows reasonable progress. In other words, there is a wide schism between what is taught in the classroom and what the test scores show. It is a realistic suggestion, therefore, to question not only the extent of the math and science content, but also how these subjects are taught to middle school children. There is a constant need for well-qualified and highly trained math and science teachers who can turn out successful students. Government and private agencies should regularly fund math and science education proposals in order to provide ongoing training for middle school teachers. This article will discuss the importance of math and science for our youths, effective ways to learn these subjects, the pros and cons of different methods of teaching, and the necessity of continuing education for teachers. The following discourse examines these issues from several perspectives.

The field of medicine has stringent requirements. Rigorous continuing medical education (CME) is required so doctors can skillfully diagnose and successfully treat their patients' illnesses. Physicians who are well trained and who have kept abreast of recent trends in their fields are in great demand professionally. Why can't we use similar standards and expectations in the teaching profession? For instance, are our middle school teachers up-to-date in their math and science content and pedagogical techniques? Are they highly sought after by parents for their content expertise and for their teaching

skills? If the answer to both questions is a definite *yes*, that is very good news for our children. If not, then we must help teachers acquire additional and relevant training to boost their math and science content and their instructional skills.

Today's students, more than ever, are required to be literate in mathematics and science and must, therefore, take full advantage of the benefits that mathematics and science knowledge can bring. This expectation creates a considerable challenge for middle school teachers in how to teach mathematics and science effectively and to integrate them with other subjects.

The Curriculum and Evaluation Standards for School Mathematics (1989) urges schools to prepare mathematically literate students who can think independently and function proficiently in the most advanced technological period in human history. *Project 2061: Science for All Americans* [(1989), which likewise emphasizes the need for a scientific-literate population, proposes that scientifically literate individuals can live productively and contribute significantly to the preservation of our fragile planet.

Everybody Counts (1989) recommends the revitalization of mathematics education in the United States. According to *The Professional Standards for Teaching Mathematics* (1991), teachers engage mainly in procedural rather than conceptual mathematics instruction. In a typical mathematics lesson, the teacher generally reviews the previous day's homework and then works some examples of the new lesson on the chalkboard or on the overhead projector. Then students, as a matter of course, spend the remainder of the period quietly at their desks--for the most part alone and sometimes with minimal interaction with one another—working on problems related to the new lesson. While students are busy completing worksheets, teachers generally sit at their desks grading papers or working on clerical matters. Occasionally, teachers will move around the classroom to offer individual help or will ask students to come to their desks for assistance. This pinned-to-the-desk routine has contributed to the creation of vast numbers of bored and befuddled students who have found mathematics unexciting, mundane, and irrelevant.

We need a new, active, and relevant approach to teaching math that will include the following: Using Cuisenaire rods, looking for symmetry in plants on a nature hike, cutting paper to make 2-dimensioal geometric shapes and measuring their areas, creating 3-dimensional objects from construction paper, and applying math skills to banking, architecture, computers, weather reports, sports, medicine, and all fields of science. A certain amount of drill and practice to reinforce math concepts can be helpful as long as teachers do not rely solely on this method of instruction.

As far as the teaching of science is concerned, The Triangle Coalition Electronic Bulletin (2006) has released the following report regarding the current state of science education in the nation, entitled "*Taking Science to School: Learning and Teaching Science in Grades K-8*" (2007). The report states that key changes are necessary to increase K-8 science achievement:

> Improving science education in kindergarten through eighth grade will require major changes in how science is taught in America's classrooms, as well as shifts in commonly held views of what young children know and how they learn, says a new report from the National Research Council. After decades of education reform efforts that have produced only modest gains in science performance, the

need for change is clear. And the issue takes on even greater significance with the looming mandate of the Federal No Child Left Behind Act, which says that states must measure students' annual progress in science beginning in 2007. Being proficient in science means that students must both understand scientific ideas and demonstrate a firm grasp of scientific practices. The report, '*Taking Science to School: Learning and Teaching Science in K-8*,' emphasizes that doing science entails much more than reciting facts or being able to design experiments.

In addition, the next generation of science standards and curricula at the national and state levels should be centered on a few core ideas and should expand on them each year, at increasing levels of complexity, across grades K-8. Today's standards are still too broad, resulting in superficial coverage of science that fails to link concepts or develop them over successive grades, the report says. Teachers also need more opportunities to learn how to teach science as an integrated whole --and to diverse student populations. Four intertwined and equally important strands comprise the committee's definition of proficiency in science. First, students should know, use, and interpret scientific explanations of the natural world. Second, they should be able to generate and evaluate scientific evidence and explanations. Third, they should understand the nature and development of scientific knowledge. And finally, students' work should include active participation in scientific collaboration and discussion.

What is needed is the type of instruction that will help middle school students, also referred to as adolescents, gain the problem-solving and critical thinking skills that are indispensable to their success in the years beyond middle school. Unfortunately, to the dismay of students and parents, learning science is, in many instances, based purely on memorizing the text, word definitions without context, and formulas without the benefit of conceptual understanding. Constructivist theorists have proposed that transmission of knowledge and delivery of information through mere lecturing, without the benefit of hands-on operations and manipulation of objects, are not conducive to conceptual learning.

In both public and private schools, the lecture method, accompanied by the completion of endless and tiresome worksheets by students, is a routine form of science instruction in many classrooms. Students are seated at their desks the entire period, so bored that they often act out their frustration. Such a classroom environment is unproductive, is not conducive to learning, and is a fertile ground for behavior problems. Classroom management experts propose that middle school students, while in the adolescent stage, should have the opportunity to learn actively and to move around the classroom from one learning station to the next in an orderly fashion. Students should not be made to sit in the same spot for long hours without the benefit of some sort of organized movement in conjunction with a learning activity.

How is student progress measured in such an inactive setting? Commonly, student progress is often measured by means of additional batches of worksheets which are to be completed either in class or at home. In addition, the results of annual *paper-and-pencil* standardized tests are also carefully considered by teachers, principals, and school

districts to determine student progress. In such a classroom environment, where is the joy of learning? This cycle of uninteresting, unexciting, and tedious instruction must end.

Today there is no excuse for not teaching any subject matter in a fun, exciting, and stimulating way so that students are actively engaged and involved in the learning process. Over the years, many parents have expressed their frustrations over staying up late at night to help their children solve repetitive math problems or write monotonous definitions of numerous science words. Other parents have supplemented their children's education with hands-on activities at the kitchen table to compensate for lack of activity at school. Can't we professionals teach our children math and science in an active way and promote conceptual learning at the same time? What can be done?

In order to motivate students to comprehend math and science concepts and explore their usefulness, teachers should use inquiry-based instruction and activity-driven opportunities for learning. The *National Science Education Standards* (1996) considers inquiry teaching to be "a multifaceted activity that involves making observations; posing questions … planning investigations . . ." (P. 23). "There is a growing consensus among educators of the value of engaging students in inquiry as part of their education in science" (Stewart, Passmore, Cartier, Rudolph, & Donovan, 2005, p. 159).

We need a new, active, and relevant approach to teaching science that will include the following: building electrical circuits, classifying spring leaves, collecting and examining colorful fall leaves, dissecting a commercially purchased earthworm, using 4-H donated eggs for hatching chicks in an incubator, transmitting sound via a taut string and two cups, dissecting a fish, constructing and flying a kite to learn about principles of flight and aerodynamics, making slides from nearby pond water to examine tiny organisms under a microscope, growing bean plants and comparing their growth in the shade versus the sun, and constructing a pinhole camera from a cup and a paper screen.

What else can be done? Integration of mathematics and science with each other and with different subjects, including social studies, language arts, and music, should be given top priority. In other words, the connectivity between math and science concepts with other areas should be routinely discussed in the classroom. This approach will demonstrate to the learner that concepts are interwoven across various disciplines. Most likely, students who receive first-rate mathematics and science education will have the necessary skills to perform successfully at the middle and high school levels. One would hope that successful and confident students would choose mathematics or a field of science as their major area of study in college. In any case, our young men and women must have a strong math and science background in order to compete in a global economy.

Improving Teacher Education: Participating in a Workshop or a Summer Institute

Should the teachers be concerned? The answer is an unequivocal *yes* as we ponder student achievement and consider students' active involvement in the learning process. There is a dire need for highly trained math and science teachers who can successfully work with middle school students and provide them with a solid foundation before entry into high school. To achieve this goal, middle school math and science teachers should continue their education and enhancement throughout the school year. When available, they should also participate in a two to four-week summer institute to retool in content and pedagogy.

As a result of participation in a summer institute or a workshop, teachers may:

1. acquire additional knowledge of math and science concepts,
2. explore math and science processes by means of hands-on teaching,
3. gain confidence in teaching these two subjects effectively using inquiry and investigative techniques,
4. become aware of opportunities for integration of math and science in the school curriculum,
5. network with colleagues for acquisition of information and resources, and
6. share the newly-acquired skills with other colleagues in their school.

To establish and organize a teacher-training summer institute, the proponents must present a clear and convincing written (as well as oral, if need be) proposal to the funding agency about why funds are needed for middle school math and science teachers in the area. A fundable proposal, in all likelihood, must discuss systemic change and be in line with the state's particular educational goals and objectives. For instance, in a proposal that was submitted to and funded by the Tennessee Department of Education, the author clearly stated that the mission and goals of his proposal corresponded well with the *Master Plan for Tennessee Schools: Preparing for the Twenty-First Century* (1993):

> Mission: "To ensure that Tennessee schools are among the best in the nation" (p. 1).
>
> Goals:
> • "All children will [be] ... able to ... solve mathematical problems effectively …" (p. 7).
>
> • "The teaching profession will attract and retain well qualified individuals who complete strong professional preparation programs and continue to grow professionally." (p. 7).
>
> • Implement the Board's new Mathematics Policy: Promote instructional practices in math and science based on National Council of Teachers of Mathematics (NCTM) standards and emerging national science standards emphasizing hands-on activities, work in small groups, problem solving approaches, and calculators and other technology (p. 10).

In the final analysis, the long-term vision of a sound and successful proposal should be to empower teachers to serve as leaders in their schools. This means working collaboratively with colleagues and providing leadership and assistance in mathematics and science instruction. For effective teacher representation at the summer institute, proposals should be all-encompassing, that is, designed to actively recruit teachers who have diverse cultural backgrounds and who work with underserved student populations.

Conclusion

Because of adolescents' boundless energy, active and experiential learning is an ideal way for middle school children to construct knowledge of new math and science concepts. Young students should be directed to creative learning activities in middle school and at home, as opposed to performing tasks that are tedious, mind-numbing, and mundane. Teachers should help children to become well-educated in math and science in order to function effectively and efficiently in this rapidly advancing technological society. A well-informed citizen is a better decision-maker; hence, it is reasonable to deduce that math/science-literate youths are able to lead productive lives as adults.

Are middle school teachers qualified to teach hands-on/minds-on math and science? Can they educate students to be problem-solvers rather than becoming sheer memorizers of facts? Teachers are in dire need of ongoing empowerment and enhancement. One effective way to meet this need is through participation in well-funded math and science workshops and summer institutes. The benefits of teacher participation are many, and may include sharing of ideas, networking with other teachers, and acquisition of pedagogical skills, materials, and equipment in order to teach students with confidence. Math-competent and science-literate students will have the necessary skills to compete beyond middle school and to experience success in high school and throughout life.

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