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# Differences between Students in STS and Non-STS Classrooms Regarding Creativity

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## Abstract

The purpose of this study is to determine the features of creativity which K-12 students display in STS (Science-Technology-Society) classrooms vs. those found in non-STS classrooms of interest, too, is how students in STS and Control classrooms differ in terms of questions posed and collected from interviews with students concerning creativity. A pre-test post-test experimental design was used in this study. The sample consisted of 463 K-12 students enrolled in STS classes and 386 K-12 students in non-STS classes. Videotapes and notes from direct observations were reviewed in terms of eight features of creativity. Interviews of a random sample of students revealed major differences of student views concerning creativity in STS and Non-STS classrooms. Interviews with a sample of students regarding creativity features were more highly developed in students who experienced science in STS classrooms.

*Keywords*: creativity, Science-Technology-Society, Iowa Chautauqua, professional development program.

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## Introduction

One fundamental aim of science education is to improve science literacy in ways that students can learn new and important concepts and meet other conditions of current national reforms. When solving problems, students can hopefully transfer what they learn to other situations (Gerber, Cavallo & Marek, 2001). The Science, Technology, and Society (STS) approach has a vital role in achieving these major goals of science education in the classrooms. Literature review reveals that students learn best if they are actually involved in the learning process (Bishop & Denley, 2007; Carin, 1993; Koch, 2000; Yager, 1991). To apply this principle, the STS teaching approach considers science in the context of what human experiences develops from the object and events all persons encounter in the natural word. Doing this provides an environment that is appropriate for all learners (NSTA, 1990-91). STS does not begin with teaching precise concepts and processes; but rather they are starting points for student involvement and interest in real-world problems. This is true for include both science and technology experienced in personal and societal frameworks. Students identify local, regional, national, and even international problems, and then investigate, analyze, and apply concepts and processes to dealing with such real-world situations in both individual and group projects efforts. Different terms have been used to describe STS programs such as context-based, everyday life experiences, socio-scientific issues, and humanistic science (Blunck & Yager, 1996).

The STS environment encourages students to have personal relationships with science experiences which prepare them for today and the future. Students work to improve their skills. One major skill enhanced by an STS environment is the ability to enhance their own personal creativity. Such personal creativity offers possible solutions while also creating environments suitable for improving students own creativity. By providing a safe environment for exploring, risk taking, and experimentation, STS is valued as students seek to apply and enhance their creative skills while solving problems (Lee & Erdogan, 2007).

No consensus exists about a definition of creativity in the literature (Fleith, 2000), but some researchers have defined creativity to be "the kind of thinking that leads to new insights, novel approaches, fresh perspectives, whole new ways of understanding and conceiving things" (Facione, 2008). Creativity is at the heart of science. It starts with questions! Creativity is enhanced as more science is done. While music, poetry, dance, dramatic literature, and innovations obviously require creative thinking and actions that can be identified as examples of employing creativity, it in less obvious ways. Science starts with asking questions and critically considering several possible solutions, or dealing with certain presumptions by imagining several different possible relationships and utilizing one to see the world in imaginative and different ways (Facione, 2008).

Although the creative process can be difficult to define, researchers generally agree that creativity involves some identifiable skills, especially when dealing with science. For this study, eight parameters were studied when assessing the nature of students' creativity; students sought to determine their ability to: 1) observe unique differences when comparing causes and effects; 2) raise unique questions regarding objects and events encountered nature; 3) offer unique ideas for taking actions; 4) suggest unique ideas suggested for gathering evidence for explanations proposed; 5) link and validate ideas/explanations suggested by other students in the group; 6) find new applications of scientific concepts, explanations and skills; 7) ask more questions than the teachers; and 8) show interest in the observations and actions of other students.

Creativity has been investigated by researchers for more than a century. Findings of these studies influenced course objectives, teaching strategies and school environments (Fleith, 2000). Torrance (1963) one of the most noted creativity scholars stated that "students in general prefer to learn in creative ways by exploring, manipulating, testing, questioning, experimenting, and testing ideas. All individuals are naturally curious; their curiosities and creativity are stimulated by relevant, authentic learning tasks of optimal difficulty and novelty for each student" (Penick, 1996, p.86). Torrance has argued that science provides more opportunities for developing creativity than most other subjects; an idea that reflects the broad support for integrating creativity into both science classes and the curriculum as a whole (McCormick & Yager, 1989; Rule, 2005).

The literature indicates clearly that teachers, teaching strategies, learning and classroom environments all have a provocative influence on student creativity (Davis, 1991; Fleith, 2000; Shin, 2000; Sternberg & Lubart, 1991; Torrance, 1981); but few studies have examined creativity in connection with STS instruction. One study (Lee & Erdogan, 2007) did aim to measure the influence of an STS approach on student creativity, with respect to questioning, reasoning, and predicting consequences. This study concluded that students taught with an STS approach develop significantly better creativity skills (with the exception of the "Questioning" as the primary sub-dimension) than did students taught with traditional methods. Another study investigated student creativity with a sample of 126 seventh and ninth grade girls (McCabe, 1991). The findings revealed significant relationship between high verbal and math IQ scores and student creativity. Other studies revealed that after STS instruction, students score significantly higher on creativity skills, as measured by Torrance Tests of Creative Thinking (Myers, 1988; Yager & Ajam, 1991).

Little attention has been given to the role of the imagination and creative thinking in science programs and very few studies have examined this issue with specific data to support the effectiveness of student learning in this realm (Enger & Yager, 1998; Penick, 1996; Yager, 2000). Appropriate time for thinking creatively, risk taking, investigation of environment, rewards for creative ideas, questioning are the components of an environment supporting the improvement of creativity and the STS teaching approach (Sternberg & Williams, 1996). Therefore, this study investigates the effect of an STS teaching approach on K-12 student creativity with respect to the eight features previously mentioned. Specific research questions framing this study are: (1) What features of creativity do students display in STS classrooms vs. those found in non-STS classrooms? (2) How do students in STS and Control classrooms differ in terms of questions posed to use in classrooms as collected from interviews with students concerning their ideas about creativity?

## Methods and Research Design

### *Sample*

Fifteen science teachers who were Teacher Leaders for the Iowa Chautauqua program participated in this study as well as fifteen others from the same or nearby schools. This data collected reports on observations of 463 K-12 students enrolled in STS classes and 386 K-12 students in non-STS classes. Data were collected over a two-year period.

### *Nature of Iowa Chautauqua Professional Development Efforts*

The main goal of the Iowa Chautauqua program is to improve science education by encouraging teachers to apply STS approaches regularly in their classrooms. The Iowa Chautauqua program has existed, since its inception in 1982. It continued as a program planned and conducted in five other states in the U.S., namely Puerto Rico, North Carolina, Texas, California, and Alaska. The program was coordinated by National Science Teachers Association (NSTA). Each Chautauqua state program was funded individually by National Science Foundation (NSF) but coordinated with very general parameters by NSTA. The Iowa Scope, Sequence, and Coordination (SS&C) project from 1990 through 1997 was funded to work in 20 school districts using STS as the defining feature for the curriculum and the desired instruction. The Iowa Chautauqua program was awarded further support from the Iowa Utilities Foundation, the Carver Trust, The U.S. Department of Education, Title IIA, the MacArthur Foundation, and with additional support from community institutions seeking to support independent school districts. A defining feature of the Iowa Chautauqua was the year long activities and the use of K-12 teachers as an essential part of staff teams and continuing efforts at each school site for at least a three year period. Iowa Chautauquas have enjoyed continuity from the early 1980s through 2006. Common to the Chautauqua series was the involvement of various teachers in varying Action Research projects for each grading period. In fact, it was a common philosophy (once proclaimed by NSTA) to make every science teacher a researcher, indicating a clear focus on searching for answers to new questions and ideas to advance exemplary teaching. Some of the goals and activities of Iowa Chautauqua program are also indicated in Figure 1.

LEADERSHIP CONFERENCE

A Two Week Long Conference Designed To

1. Prepare staff teams for conducting a workshop series which enrolled up to 30 new teachers.
   a) One lead teacher per ten new teachers
   b) Scientists from a variety of disciplines
   c) Scientists from industry
   d) School Administrators
   e) Science Supervisors/Coordinators
2. Organization and scheduling for each workshop
3. Publicity and reporting
4. Assessment strategies
   a) Six domains for assessing students for teaching effectiveness
   b) Use of past reports and sample instruments and techniques
   c) Action Research (Every teacher as researcher)
   d) New research plans for the successful teachers that were instructional partners

THREE OR FOUR WEEK SUMMER WORKSHOP

Learning Experiences

1. Includes special activities and field experiences that relate specific content within the disciplines of biology, chemistry, earth science, and physics.
2. Makes connections between science, technology, society within the context of real world issues and in terms of meeting the four goals elaborated in the NSES, p. 13..
3. Issues such as air quality, water quality, land use/management are used as the contexts for concept and process skill development.
4. Focuses on problems/issues in the school and local communities.
5. Enrollees develop materials for use in peer teaching as well as specific plans for teaching a 5-10 day mini-module prior to the fall short course.
6. Decisions regarding specific evidence needed to assure that each goal was achieved.

ACADEMIC YEAR WORKSHOP SERIES

| Fall Short Course (3 days) → | Interim Projects → | Spring Short Course (3 days) |
|---|---|---|
| Awareness Workshop<br><br>**<u>20 hr Instructional Block</u>**<br>(Thursday pm. Friday, & Saturday)<br><br>Activities Include:<br>1. Review problems with traditional views of science and science teaching<br>2. Outline essence of new instructional strategies<br>3. Define techniques for developing new modules and assessing their effectiveness<br>4. Select a tentative module topic<br>5. Practice with specific assessment tools in each Domain.<br>6. Use Lesson Study designs<br>7. Analyze one videotape of one class prepared for use in the Short course to be Shared with total group | Three Month Interim Projects<br><br>**<u>Developing More Modules</u>**<br><br>Activities Include:<br>1. Developing instructional plans for minimum of twenty days<br>2. Administer pretests in six domains<br>3. Teach one complete module (3-4 weeks)<br>4. Collect posttest information<br>5. Communicate with regional staff, Partner Teachers, and central Chautauqua staff<br>6. Complete and analyze one class videotape with colleagues from given sites<br>7. Decide on other modules to be tried | Final Workshop<br><br>**<u>20 hr Instructional Block</u>**<br>(Thursday pm. Friday, & Saturday)<br><br>Activities Include:<br>1. Report on new instructional experiences<br>2. Report on all assessment efforts<br>3. Interact with new information concerning the new teaching strategies elaborated in the NSES, p. 52<br>4. Show and discuss one videotape of teaching in one class<br>5. Analyze changes from summer, fall, and spring<br>6. Plan for involvement in continuing professional meetings<br>7. Plan for next-step initiatives (including complete reorganizing of existing courses and helping with new workshop series) |

Figure 1. *The Iowa Chautauqua Model for Professional Development of Science Teachers*

Although the Chautauqua Programs operated on a continuing basis, an annual sequence of events describes its basic features which are proposed as a model for use elsewhere. The sequence of events for the Chautauqua Program includes: (1) A two-week leadership conference for 30 of the most successful teachers from previous years who will become a part of the instructional team for summer workshops, consisting of as many as five workshops across the State each year; (2) Four week summer workshop at as many as five new sites each for 30 new teachers electing to try STS modules and strategies; the workshop provided experience with new instructional strategies (participating teachers as students) with time to plan a five-day unit to be used with students in the fall; (3) Use of a five-day mini-unit in the classroom during September or early October; (4) A three day fall short course for 30-50 teachers (including the 30 enrolled at varying sites during the summer); the focus is upon developing a month long module and an extensive assessment plan; (5) A series of interim communications with central staff, lead teachers, and fellow participants, including a newsletter, special memoranda, monthly telephone contacts, and school/classroom visits; and (6) A three-day spring short courses for the same 30-50 teachers who participated in the fall; this session focuses upon reports by participants concerning their experiences and the results of the assessment program, including specific Action Research projects. Also, of importance, is a discussion of how whole courses could change for the enrolled teachers for the next academic year.

### *Data Collection Procedures*

Fifteen STS teachers who were leaders and advocates for the Chautauqua program were asked to undertake a two-year project to monitor and encourage the development of our eight features of creativity in K-12 science classrooms for grades 5 through 10. Each of the fifteen leader teachers found a partner teacher; together they made pre- and post-testing assessments of actual instruction, by reviewing three days of videotaped classroom occurrences. The partner was to be a teacher of the same grade level, but without previous experience with a funded, professional development program like Chautauqua. Many of the "control" teachers were eager to help and to share their classrooms and their students, but they were not informed of our interest in the importance of creativity in science classrooms.

Chautauqua prepared teachers consistently used STS teaching strategies; the control teachers, however, taught using traditional methods. To compare the two methods, the same instruments were applied for students in both sections. In STS and non-STS groups, students were almost equal with respect to gender, socioeconomic levels, class sizes, average grades, extracurricular activities, and previous science grades; both groups also used the same textbooks for the "curriculum" followed. The only difference was that STS classes integrated various activities with the STS methodology, which encouraged students to ask their own questions and discuss them with other students in the classroom. They often used the textbook for finding needed information instead of its providing a framework for the discussions.

In the STS classrooms the teacher's role in STS classes was that of bring a facilitator. Teachers in STS classrooms tried to establish an environment in which students would actively undertake investigations and participate in discussions with other students. On the other hand, teachers in non-STS classrooms played controller roles, providing detailed information and explaining it through lectures or demonstrations—invariably teacher-centered teaching. To overcome possible internal validity threats such as implementation or implementer bias, teachers were asked and given information to minimize such threats. Besides this, teaching in the STS and Non-STS classrooms were observed and analyzed by means of classroom videotapes for treatment fidelity by special researchers (often PhD students) who were familiar with criteria for the treatment.

### *Data were collected from varying classrooms concerning the use of Creativity*

Videotapes and notes from direct observations were reviewed in terms of the aforementioned features of creativity. Lead teachers also used the videotapes later, as examples of STS teaching in on-going Chautauqua sessions. For this research report, three videotapes were randomly selected from nearby schools and used to indicate changes in how students understood and used creativity traits. The selected tapes for each teacher (15 with STS experiences and 15 without any professional development preparation) were viewed as pre-tests and after instruction for one semester and as post-tests after 5 months in each teaching situation.

The videotapes were made available as a regular aspect of the Chautauqua experiences. Five research assistants (from the Iowa graduate program) studied and reviewed videotapes for features of creativity. The reviewers were blinded in terms of the schools involved and the STS or non-STS status of the videotaped teachers and classrooms. Another instrument was a protocol for detailing questions for students related to creativity. The five questions were provided by interviewers which included the following:

### *Interview Questions Used to Collect Information Pertaining to Creativity*

1) Identify three adjectives that indicate your description of creativity in a classroom.

2) Assuming creativity can be enhanced, provide three ways it can be improved in a semester long science course.

3) Provide three examples of "creativity enhancement" used by the science classroom/teacher.

4) Indicate three traits of the most creative person you know.

5) Assuming you have been described as a creative person, indicate three traits you would use to indicate such an evaluation.

### *Data Analyses*

Videotape analyses, frequency analyses and *Mann-Whitney U Test* were collected in an attempt to determine the features of creativity of students thought by Chautauqua teachers and teachers in control classrooms.

Data were collected to provide indication of evidence for the use of STS strategies in classrooms. Also, interviews were analyzed to evaluate the differences between student answers about creativity in STS and Control classrooms. The research team administered the questions for one class section taught by each of the Chautauqua staff team and similar questions for one section taught by a teacher without any Professional Development experience - especially tied to creativity. In some instances teachers were asked to provide the answers to the questions; in other instances school counselors were used to get the information - often in a 15 minute time frame.

## Results

The videotapes and observations from class visits to evaluate and compare student features of creativity, as described above were analyzed. More than 90% of students in STS sections displayed evidence that they were applying newly learned scientific concepts, explanations, and skills, as compared to only 10% of those in non-STS sections. The observations were also monitored to determine the development of other features of creativity: the uniqueness of ideas offered for taking actions; the uniqueness of ideas suggested for gathering evidence for proposed explanations; interest in the observations and actions of other students. In STS sections, more than 80% of the students displayed these features and were well developed compared to below 10 % of the students in non-STS sections.

More than 70% of the STS students observed unique differences comparing causes and effects, and the number of students who raised unique questions regarding objects and events in nature were compared to almost 20% of the students in the non-STS sections. Approximately 66% of the students in STS classes made more links to, and validations of, ideas suggested by other students; further they asked more questions than did their teachers. In non-STS students, the most highly developed creativity feature was the skill of observing unique differences in comparing causes & effects (23%); the least developed feature - and one not observed by any of the non-STS teachers - was asking more questions than the teachers. Specific results are shown in Table 1.

Table 1. *Percentage of Observed Features of Students Illustrating Creativity in the STS and Non-STS Sections*

| Observed Features of Students Illustrating | STS* (%) | Non-STS* (%) |
|---|---|---|
| Unique differences when comparing causes & effects | 71 | 23 |
| Unique questions raised regarding objects and events in nature | 79 | 18 |
| Unique ideas offered for taking actions | 83 | 3 |
| Unique ideas suggested for gathering evidence for explanations proposed | 87 | 6 |
| Linkages and validations to ideas/explanations often suggested by other students | 65 | 4 |
| New applications/use of science concepts, explanations, and skills | 94 | 10 |
| Students asking more frequent questions than do teachers | 68 | 0 |
| Interest by the observations and actions of other students | 88 | 9 |

It is apparent that the students taught by STS Teacher Leaders who had been enrolled in the Iowa Chautauqua program were able to develop all eight of the creativity features monitored. All of these features showed dramatic differences between students experiencing STS and those of students in non-STS sections. Results are presented in graphic format as Figure 2.

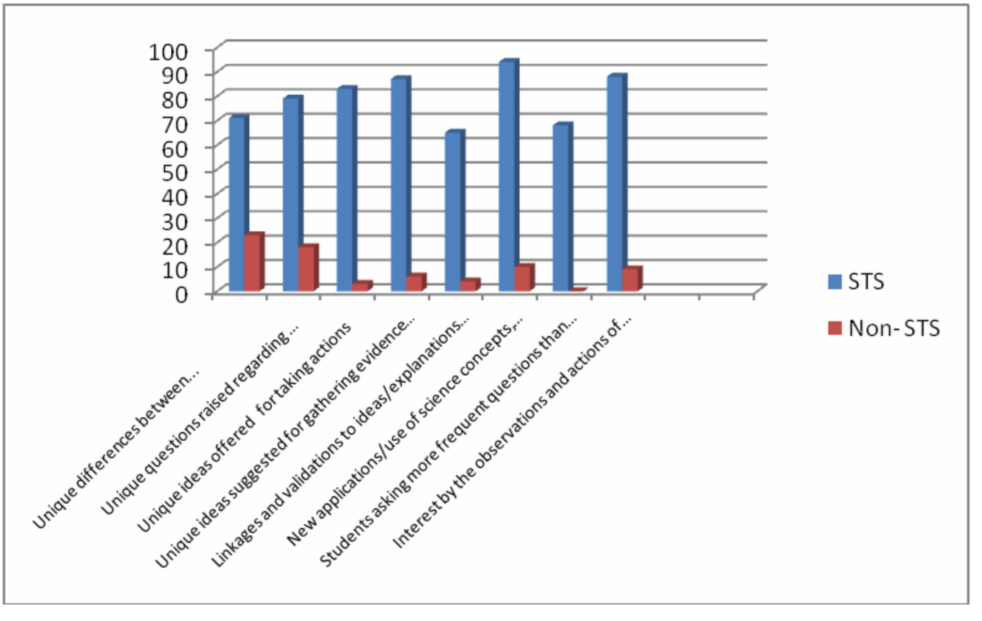


Figure 2. *Comparison of ten features related to creativity between students taught by the STS vs. those experiencing a non-STS teaching approach*

*Mann-Whitney U Test* was conducted to evaluate the differences between STS group and Non STS group with respect to creativity aspects. Results showed that there is statistically significant difference between creativity aspects in STS group and those of Non-STS group (z value is -3.361 with a significant level of Asymp. Sig. pâ.001). Interview questions were asked to a sample of students to assess the students' views of creativity and the role of creativity in their science classrooms. In all cases, the researchers found that students from STS classes scored higher in terms of well-developed creativity traits as compared to students educated in more traditional classrooms, where textbooks and teacher directions dominated the curriculum and the associated instruction. These results exemplify how STS enhances creativity for K-12 students. Student results were summarized in five tables which provide indicators of student views of creativity - as reported from interviewing students from STS and non-STS classrooms.

Table 2. *Typical Adjectives Offered by Students to Indicate Descriptions of Creativity*

| STS | | Non-STS | |
|---|---|---|---|
| Ideas<br>Unique<br>Applications<br>Complex<br>Questioning<br>Exploring<br>Evidence | Different<br>Exciting<br>Personal<br>Scarce<br>Complex<br>Wondering | Unused<br>Music<br>Unusual<br>Enthused<br>Excited<br>Arts | Different<br>Entertaining<br>Youth<br>Bubbly<br>Outgoing |

Table 3. *Student Interpretation of Creativity in a Semester Long Science Course Designed to Enhance It*

| STS | | Non-STS | |
|---|---|---|---|
| Set up contests for uniqueness<br>Practice differentiating between causes and effects<br>Identify possible consequences<br>Use of questions<br>Encourage unique questions<br>Projects (individual and group)<br>Laboratories organized by students | Contests in defining unique uses of evidence<br>Encourage different ideas<br>Questions<br>Evidence collected<br>No use of textbook for identifying new ideas<br>Investigate its use by interviews with practicing scientists. | Practice different approaches<br>Contrast actions in science with other fields<br>Practice with classmates (reporting and enlarging explanations)<br>Ask teacher for specifics questions<br>Specific questions for others | Look at successful people that provide examples<br>Encourage asking teacher for more help<br>Add items to ideas from textbooks and text teacher's guides<br>Ask scientist for hints about use of new information |

Table 4. *Student Examples of "Creativity Enhancement" Reported to have been used by Their Science Teacher*

| STS | | Non-STS | |
|---|---|---|---|
| Student choices of questions to raise<br>Encourage various explanations from students<br>Encourage student–student discussions<br>Student ideas for assessment (and use of the concepts and success used)<br>Focus on use of outside class time | Examine student uniqueness<br>Value unique work by industrial and groups of students<br>Encourage problems from local communities scientists and engineers to be used to define classroom activities<br>Use student located experts to help and to suggest creativity | Encourage extension to classroom students<br>Specialty lab work<br>Encourage students to remember information from classes for grading | Exciting ideas for students to try<br>Samples of creative people in society generally<br>Include nature and history in science discussions |

Table 5. *Student Responses When Asked to Indicate the Traits of the Most Creative Person They Know*

| STS | | Non-STS | |
|---|---|---|---|
| Unique ideas and actions<br>Experience the total sequence of doing science<br>Intrigue with complexity of ideas<br>Unique approaches to solving problems | Doubting first ideas<br>Propose new discoveries<br>Collaborative efforts<br>Focus on problem solving | Out going<br>Fun<br>Entertaining<br>Unusual<br>Non-conformist | Independent<br>Concern for other people<br>Professional<br>Extravert |

*Table 6.* Students were Asked to Indicate Three Traits They Felt Would Indicate such an Evaluation Traits of Creativity

| STS | | Non-STS | |
|---|---|---|---|
| Expectation of needed evidence for all proposed explanations<br>Liking for the unusual<br>Encouraging information gathering and possible explanation | Expectation of direct involvement<br>Intrigued with all observations of the objects and events characterizing the universe<br>Evidence of thoughts designed to answer questions | Entertaining<br>Outgoing personality<br>Not a follower<br>Unusual ideas/interests | Leader in terms of possible approaches<br>Need and desire to know current explanation of the "workings" of nature |

## Discussion

The creativity features measured were more highly developed in students who experienced science in STS classrooms. This is likely because the STS environment provides students with ample opportunities to apply concepts and to actively participate in activities while the textbook-oriented classroom environment offered few such opportunities. Moreover, the traditional classroom settings usually start with an externally directed curriculum (or textbook) in which students are sitting and listening, watching demonstrations, and taking notes. On the other hand, STS students are active participants, following their own line of questions, offering their own responses to questions, and dealing with real-world problems. In addition, the STS approach generates a learning environment where creativity is valued, encouraged, modeled, and rewarded (Penick, 1996). It became a "sought out" features and procedures.

The extent of creative learning opportunities depends on how individual students learn and what role they play in classrooms (Cronin, 1989). Fleith (2000) indicated the idea that teacher attitudes, strategies, and activities were encouraging components of classroom environments which improve student creativity skills. These features of the learning environment support STS approaches found in this study. In the STS groups, the students designed and carried out their own investigations, while the teachers identified and directed problem-solving activities in the other sections. The learning environments of the STS sections conformed to the basic tenets of the STS approach: they were student-centered, and emphasized "autonomy as opposed to obedience, construction as opposed to instruction, and interest as opposed to reinforcement" (Airasian & Walsh, 1997, p. 446). The students in non-STS sections experienced more traditional teacher centered situations. The findings support previous research which indicated that creative thinking skills can be learned with practice (Cronin, 1989) and that education grounded in the STS approach better promote development of student creativity (Cronin, 1989; Lee & Erdogan, 2007; Shin, 2000; Torrance, 1981; Yager, 1996; Yager, & Akcay, 2008).

Another factor influencing student creativity might be the level of freedom found in classrooms. According to Erez (2004), freedom is a necessary precondition for creativity, which is provided with an alternatively atmosphere of freedom. Too often students cannot formulate original ideas or ask questions in different ways. The STS approach contributes to an atmosphere of freedom in which students can generate and raise their own questions without following the textbook or specific teacher directions. This atmosphere of freedom helps students learn how science is relevant to them personally while also improving creative thinking – both in terms of quantity and quality.

## Conclusions

In this study, major differences were found in the extent that creativity skills were identified and used when compared with results in control groups of students taught with traditional methods. STS approaches are effective in encouraging students to become more interested in and motivated to study science. In STS courses, students address real-word problems and are encouraged to investigate and find solutions. These students manifested their enhanced creativity by extending what they learned to new situations. In contrast, students educated in the non-STS section were far less able to extend newly acquired ideas and skills to new situations. Students in STS sections used their creativity to exemplify the nature and practice of science itself.

The results strongly support the use of ongoing professional development programs designed to help teachers consistently employ STS approaches in their own classrooms. University workshops or Professional Development programs should include experience and teaching approaches used for both pre-service and in-service programs should focus on creativity. Moreover, creativity issues should be considered while rearranging curricula; teachers should carefully select learning strategies that improve student questioning and creativity. Such teaching should be openly encouraged and modeled as characteristic of exemplary STS programs.

Creativity can be identified as one "enabling domain" which could help all science teachers to reach the reform guidelines for teaching that are currently offered in the National Science Education Standards (NRC, 1996).

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