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The effects of science in motion on self-efficacy beliefs regarding teaching science as inquiry

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Abstract
The purpose of this study was to investigate the effects of the Science in Motion (SIM) program on the self-efficacy beliefs of high school science teachers regarding the teaching of science as inquiry. The instrument used in the study was the, Teaching Science as Inquiry (TSI) Instrument - In-service Version. The TSI Instrument was administered to 75 high school teachers to measure the self-efficacy beliefs of the teacher participants in regard to the teaching of science as inquiry. Based on the results and the associated data analysis, SIM non-users were shown to have slightly higher self-efficacy scores than SIM users.

Keywords: Self-efficacy, science, inquiry

Introduction

Current reform documents emphasize the importance of inquiry-based instruction for all students (American Association for the Advancement of Science [AAAS], 1993; [1] National Commission on Excellence in Education [NCEE], 1983; National Research Council [NRC], 1996 [52]; National Research Council [NRC], 2000) [27]. The push for inquiry teaching and learning stems from research that links inquiry-based instruction to higher student achievement (Anderson, 1997; Burkam, Lee, & Smerdon, 1997; Carey, 1985; Freedman, 1997; Lott, 1983; Shymansky, 1984; Uno, 1990; Von Secker, 2002; Von Secker & Lissitz, 1999; Wells, 1995) [2, 21, 22, 31, 45, 72, 90, 85, 86, 89], increased people skills, scientific knowledge growth, student motivation (Kleine, Brown, Harte, Hilson, Malone, & Moller, *et al*., 2002; Wells, 1995) [40, 89], increased memory (Tamir, 1983) [76], and better student attitudes (1984). Although inquiry teaching and learning is a cornerstone of current science reform and has been proven to be an effective teaching strategy (Costenson & Lawson, 1986; Lott, 1983; Wells, 1995) [24, 45, 89], its implementation into high school science classrooms has yet to become a consistent characteristic (Czerniak, 1995; 1986; Damnjanovic, 1999; Drayton & Falk, 2000; Hurd, Bybee, Kahle, & Yager, 1980; Llewellyn, 2005; Tal & Argaman, 2005; Wallace & Kand, 2004; Wells, 1995; Windschitl, 2002) [25, 26 27, 37, 43, 75, 87, 89, 91].

Researchers have reported many challenges that teachers of inquiry-based instruction face that may be contributing to the low priority of inquiry-based instruction in high school science classrooms. Some of those challenges associated with inquiry-based instruction were identified by Costenson & Lawson (1986) [24] who explained that "too much time must be devoted to developing good inquiry materials and too much energy must be expended to maintain enthusiasm" (p. 151) each day, inquiry teaching and learning "is too slow" (p. 152), "students are too immature" (p. 156), and teachers "do not feel comfortable not being in control of what is going on" (p. 157). Teachers have also reported other challenges with inquiry teaching and learning such as "safety issues, lack of equipment, management difficulties, and the need to teach a mandated curriculum" Wallace & Kand, 2004, p. 939) [87]

Although there are a number of challenges associated with the implementation of inquiry teaching and learning, one major challenge is that many high school teachers have not conducted inquiry-based investigations while teaching or learning themselves (Kleine *et al*, 2002; Tamir, 1983; Windschitl, 2002) [40, 76, 91] and have therefore had difficulty accepting and implementing inquiry teaching and learning into their own classroom practices (Damnjanovic, 1999) [26].

Many teachers believe that because they lack experience with inquiry teaching and learning, they are not competent enough to conduct inquiry-based investigations with their students (Hurd, Bybee, Kahle, & Yager, 1980) [37]. These beliefs can play a major role in teacher decision-making regarding their behavior in the classroom (Fang, 1996; Kagan, 1992; Thompson, 1992; Tschannen-Moran & Woolfolk-Hoy, 2001; Woolfolk-Hoy & Spero, 2005) [30, 39, 77, 79, 92]. In fact, Pajares (1992) [56] asserts that beliefs are the "best indicators of the decisions that individuals make throughout their lives" (p. 307). One way to understand the low priority of inquiry teaching and learning is to investigate how self-efficacy beliefs affect teacher behavior regarding the teaching of science as inquiry.

Albert Bandura (1997) [14] explained that "self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Self-efficacy beliefs have been shown to be strong predictors of human behavior (Bandura, 1977; Ghaith & Yaghi, 1997; Gibson & Dembo, 1984; Guskey, 1988; Pajares, 1992; Singer, Marx, Krajcik, & Clay Cambers, 2000; Windschitl, 2002) [10, 11, 32, 33, 35, 56, 73, 91,]. Further, teacher self-efficacy beliefs have been shown to be good predictors of teacher behavior in science classrooms (Bandura, 1986; Riggs & Enochs, 1989; Woolfolk-Hoy & Spero, 2005) [92, 63]. Self-efficacy has also been linked to student achievement (Armor, Conroy-Osequera, Cox, King, McDonnel, Pascal, *et al*., 1976; Ashton & Webb, 1986; Berman, McLaughlin, Bass, Pauly, & Zellman, 1977; Gibson & Dembo, 1984) [3, 4, 15, 33]. In addition, self-efficacy has been linked to teacher's willingness to implement new instructional techniques (Berman, McLaughlin, Bass, Pauly, & Zellman, 1977; Guskey, 1984; Rose & Medway, 1981) [15, 36], positive attitudes about teaching (Guskey, 1984) [36], teacher stress (Greenwood, Olejnik, & Parkay, 1990; Parkay, Greenwood, Olejnik, & Proller, 1988) [57], time spent teaching science (Riggs & Jesunathadas, 1993) [66], and the teaching of science as inquiry (Author, 2006; Author, 2008) [5, 6].

In order for inquiry teaching and learning to become more of a priority in high school science classrooms, teachers must first be provided with support and opportunities to experience inquiry-based instruction (Kleine *et al*., 2002) [40]. Professional development programs can be a means of providing support to teachers who need it (Avery & Carlsen, 2001) [7]. Previous research has shown that professional development programs can assist "teachers in augmenting their science content knowledge and confidence to teach science" (McDonnough, McKelvey, Baski, & Lewis, 2004, p. 67) [49] increase positive teacher attitude toward inquiry-based instruction (Lawrenz, 1984; Lott, 2003) [42, 46], and increase content knowledge of subject area (Clermont, Krajcik, & Borko, 1993; Avery, Trautmann, & Krasny, 2003; Turner, Cruz, & Papakonstantinou, 2004) [8, 23, 83]. Professional development programs can also increase the self-efficacy beliefs of teachers (Borchers, Shroyer, & Enochs, 1992; Turner, Cruz, & Papakonstantinou, 2004; Watson, 2006) [16, 83, 88]. The support from an appropriate professional development program may also be able to foster change in the self-efficacy belief structures that high school science teachers have regarding the teaching of science as inquiry (Avery, Trautmann, & Krasny, 2003; Knox, Moynihan, & Markowitz, 2003; 1984; Lott, 2003) [8, 41, 46].

One such program that could potentially influence teacher self-efficacy beliefs is the Science in Motion program (SIM). SIM is a professional development program of 11 college sites that focuses on improving science education and supporting high school teachers in Pennsylvania. The program offers teachers an array of laboratory equipment and materials and it provides a staff of certified secondary science teachers to assist in using the equipment and materials. In addition, it provides technology support. This program is offered in an effort to improve science instruction. This service is offered free of charge to any high school teacher within a 60 mile radius of the SIM site. SIM also offers an array of workshops, professional development opportunities, dinner meeting activities, and training sessions throughout the year. SIM may be able to provide the personnel, equipment and support needed to encourage inquiry-based teaching in high school classrooms.

As such, the purpose of this research was to investigate the effects of the SIM program on the self-efficacy beliefs of high school science teachers regarding the teaching of science as inquiry. This research will examine both teachers who use and who do not use the SIM program to determine if a difference exists in their beliefs regarding the teaching of science as inquiry, and to what extent this difference may influence the implementation of inquiry-based instruction in the classroom.

Review of Literature

Defining Inquiry Teaching and Learning

Inquiry as a construct has been broadly defined and applied since its conception. It has been said that Socrates used inquiry as he "quizzed and prodded his students toward an understanding of ideas through a series of questions and responses" (Uno, 1990, p. 842) [90] In 1962, reform advocate Joseph J. Schwab defined enquiry as "a process of discovery-discovery in the very special sense of the construction of scientific knowledge by the interpretation of data through use of conceptual principles of the enquiry" (Schwab, 1962, p. 28) [70] His ideas on enquiry, which were analogous to those of inquiry despite the spelling variation, called for a "virtual revolution in the teaching and learning posture which has characterized American science education in the past" (1962, p. 5).

More recently the National Research Council (NRC) defined inquiry as "the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work" (NRC, 1996, p. 23) [52]. They assert that:

inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations (p. 23).

Thus, inquiry-based instruction can have various meanings depending on the resource. Despite the fact that inquiry can be described in many ways, for the purpose of this research, the definition set forth by the National Research Council (NRC, 1996) [52] will be utilized. This definition of inquiry relies on the *National Science Education Standards* which provide "the most comprehensive presentation to date of a vision of a standards- and inquiry-based classroom" (Drayton & Falk, 2000, p. 16) [27]. This "approach emphasizes that science is the process of gaining knowledge (especially of the natural world), and that gaining knowledge is not the accumulation of facts but the development and enrichment of theories, explanations, and rigorous stories about how the world works" (Drayton & Falk, 2001, p. 26) [28]. This definition "distinguishes inquiry-based teaching and learning from inquiry in a general sense and from inquiry as practiced by scientists" and "is derived in part from the abilities of inquiry, emphasizing questions, evidence, and explanations within a learning context" (NRC, 2000, p. 24) [53].

The cornerstone of the NRC (2000) [53] definition of inquiry is the five essential features of classroom inquiry teaching and learning. The five essential features are as follows:

- Learner engages in scientifically oriented questions
- Learner gives priority to evidence in responding to questions
- Learner formulates explanations from evidence
- Learner connects explanations to scientific knowledge
- Learner communicates and justifies explanations (p. 29).

These five essential features have variations that range from student-directed to teacher-directed learning. Thus, teachers have the option to vary the amount of guidance and assistance they provide. "The degree to which teachers structure what students do is sometimes referred to as 'guided' versus 'open' inquiry" (NRC, p. 29).

According to the NRC (2000) [53], teachers also have the option to vary the organization or the sequence of the inquiry-based lesson by considering the lesson as either full or partial. A full inquiry consists of all five essential features but if one or more essential features are missing the inquiry is referred to as a partial inquiry (2000). For example, a lesson will be considered partial if students are not initially engaged in a scientifically oriented question but rather assigned a project (2000). Regardless of the type of lesson, "students should have opportunities to participate in all types of inquiries in the course of their science learning" (NRC, 2000, p. 30) [53] because continued research highlights the benefits of inquiry-based instruction (Anderson, 1997; Burkam, Lee, & Smerdon, 1997; Kleine *et al*., 2002; Lott, 1983; Shymansky, 1984; Uno, 1990; Von Secker, 2002; Von Secker & Lissitz, 1999; Wells, 1995) [2, 21, 45, 72, 90, 85, 86, 89].

According to the NRC (1996) [52], "students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments" (p. 105). The exact way that teachers implement inquiry-based instruction may be dependent on the grade level of the class. The *National Science Education Standards* as described by the NRC are divided into three separate grade levels, K-4, 5-8, and 9-12 (1996). Each grade level has *National Science Education Standards* specific to those grades that "help science educators define what students should know and be able to do" (Llewellyn, 2001, p. 6) [43]. Thus, each grade level has a unique way to incorporate inquiry-based instruction.

The NRC (1996) [52] further recommends that teachers use inquiry-based instruction at levels that are appropriate for students according to their developmental capabilities. "In elementary grades, students begin to develop the physical and intellectual abilities of scientific inquiry. They can design investigations to try things to see what happens" (p. 122). "Students in grades 5-8 can begin to recognize the relationship between explanation and evidence. They can understand that background knowledge and theories guide the design of investigations, the types of observations made, and the interpretations of data. In turn, the experiments and investigations students conduct become experiences that shape and modify their background knowledge" (p. 143). "In grades 9-12, students should develop sophistication in their abilities and understanding of scientific inquiry. Students can understand that experiments are guided by concepts and are performed to test ideas" (p. 173). As a result, the NRC (1996) [52] asserts that inquiry-based instruction is appropriate for all grade levels but the activities will need to be adjusted depending on the developmental abilities of students in each grade.

Research on Inquiry Teaching and Learning

The NRC (2000) [53] asserts that "a classroom in which students use scientific inquiry to learn is one that resembles those that research has found the most effective for learning for understanding" (p. 124) and significant research supports the benefits of inquiry-based learning. Uno (1990) [90] stated that "inquiry is a way to rejuvenate a student's curiosity about the world, and it may help students to become more open, to take more risks and responsibilities in class, and to be more objective and precise. Students will learn that science is a dynamic process of investigation, not a static collection of inalterable facts" (p. 843).

Furthermore, Drayton and Falk (2000) [27] observed that when introduced to inquiry learning "students were more likely to participate in hands-on activities, to revisit their work, to work in pairs or small groups, and to share strategies. Students were more likely to collect and discuss data. Teachers were less likely to give content lectures, to offer demonstrations, and to have students take notes either on the text or on their lecture" (p. 16). This is important because inquiry-based instruction is not a "process versus content" debate (Drayton & Falk, 2001, p. 25) [28]. Rather, it is a way of combining process and content in an effort to develop sophisticated understandings.

Research has shown that "inquiry lessons lifted the external constraints and opened doors for student spontaneity and moments of insight" (Kleine *et al*., 2002, p.38) [40]. The same researchers also found that when inquiry-based instruction was implemented, "generally more students were motivated to participate in lessons than usual…and that students who rarely had successful academic experiences became more motivated" (p. 38). In addition, "Lott (1983) [45] conducted a meta-analysis of 39 studies published from 1957 through 1980, and found that, when compared to the lecture approach, the inquiry approach led to significantly better performance when high levels of thought were considered and to essentially equal performance on low level cognitive outcomes" (Costenson & Lawson, 1986, p. 150) [24]

Research also suggests that inquiry-based opportunities can also be effective for students with disabilities (Boyd & George, 1973; Borron, 1978; Morocco, Dalton, & Tivnan, 1990; Shulene, 1972; Trundle, 2008) "including those with intellectual impairments" (Mastropieri & Scruggs, 1992, p. 387). In fact, these students "who actively reasoned through causal explanations exhibited higher recall and higher comprehension than students who had simply been provided with the information" (1992, p. 387). "The research focused on true inquiry is quite clear-it is effective in a variety of ways" (McComas, 2005, p. 29). Therefore, it is important for all students to be involved in inquiry-based instruction in high school science classrooms.

Reform Efforts on Inquiry Teaching and Learning

In response to research highlighting the benefits of inquiry-based instruction, the science education community has published major reform reports that call for the inclusion of inquiry-based teaching. In 1983, the U.S. Department of Education's National Commission on Excellence in Education (NCEE) published *A Nation at Risk: The Imperative for Educational Reform*. This report, cited often as the origin of educational reform, reported that American schools are failing and as a result our nation is being taken over by competitors across the globe. The report brought attention to and made science education reform a priority once again. It described a different approach to teaching science at the high school level. Specifically, one of the recommendations for science called for high school graduates to use "methods of scientific inquiry and reasoning" (p.25). Research has shown that it is through these methods that the most effective student learning takes place (Wells, 1995) [89].

In 1993, another prominent report, *Benchmarks for Science Literacy Project 2061*, was published by the American Association for the Advancement of Science (AAAS). The report focused on recommendations for science teachers and students that were aimed at developing science literacy. According to the report, inquiry-based investigations must be included in science education in order to produce scientifically literate students. The thorough report presented "statements of what all students should know or be able to do in science, mathematics, and technology by the end of grades 2, 5, 8, and 12" (p. XI). The report notes that "before graduating from high school, students working individually or in teams should design and carry out at least one major investigation. They should frame the question, design the approach, estimate the time and costs involved, calibrate the instruments, conduct trial runs, write a report, and finally, respond to criticism" (p. 9). Although constructed by different associations, both reports aimed to promote inquiry-based instruction in science education for the purpose of providing all students the best education possible.

In 1996, the National Research Council (NRC) released the *National Science Education Standards* which were developed parallel but separate from *Benchmark for Science Literacy Project 2061*. "The result was a document that, since its release, has been a driving force behind U.S. science education" (NRC, 2000, p. xv) [53]. "The *National Science Education Standards* are designed to guide our nation toward a scientifically literate society. A main component of the *National Science Education Standards* is inquiry teaching and learning used as a means to teach and learn scientific concepts.

Resistance to Inquiry Teaching and Learning

Despite recent legislation and research highlighting the effectiveness of inquiry-based instruction, evidence suggests that inquiry-based instruction is still not a prominent feature in today's science classrooms (Costenson & Lawson, 1986; Drayton & Falk, 2000; Hurd, Bybee, Kahle, & Yager, 1980; Llewellyn, 2005; Tal & Argaman, 2005) [24, 27, 37, 44, 75]. In fact, "a report from the U.S. Department of Education (O'Sullivan & Weiss 1999) on student work and teacher practices found that 69% of U.S. 12th graders 'never or hardly ever' designed and carried out their own scientific investigation" (McComas, 2005, p. 27) Further, "in a study conducted with an elementary science methods class, Shapiro (1996) found that 90% of her students had never experienced science as an investigation, and most of those who had, did so in school science fairs" (Windschitl, 2002, p. 117) [91] "In short, little evidence exists that inquiry is being used" (1980, p. 391). This is disheartening because of the current research supporting the benefits of inquiry-based instruction as well as the state and national mandates calling for the implementation of inquiry-based instruction.

The low priority of inquiry-based instruction in high school science classrooms can be explained by many challenges that teachers face. Many teachers feel that "only highly motivated, gifted students can benefit from inquiry teaching; thus, its use is limited to advanced classes offered to talented students" (Hurd, Bybee, Kahle, & Yager, 1980, p. 391) [37]. Other reasons include that inquiry teaching "takes too much time" and "too much energy" (p. 151). Teachers also believe that inquiry teaching and learning as a process "is too slow" (p. 151), "students are too immature and waste too much time" (p. 156) to engage in inquiry-based learning, and it costs too much (Costenson & Lawson, 1986) [24]. Additionally, Llewellyn (2001) [41] states "many science teachers are comfortable with doing prescribed activities, or cookbook labs, because they can anticipate the outcome of the experiment or the lab is correlated to a particular concept in the science curriculum" (p. 76).

Further challenges lie with the fact that "that teachers are not convinced that inquiry teaching really works and, with the myriad demands on their energy, they wonder whether teaching by inquiry is a worthwhile endeavor" (Kleine, *et al*., 2002, p. 36) [40] In fact, a study on challenges with inquiry-based instruction noted that in six districts, "teachers spoke of how these challenges were exacerbated or ameliorated by school or system-wide structures, and by other competing or complementary reforms" (Drayton & Falk, 2000, p. 16) [27]. Therefore, teachers may believe that the implementation of the new reform efforts involved in inquiry teaching will be overwhelming and involve too many obstacles (Costenson & Lawson, 1986) [24]. These reasons may help to explain why inquiry teaching and learning is not more of a priority in high school science classrooms.

In addition to the many challenges stated, one major reason to explain the low priority of inquiry teaching may lie in the fact that today's high school science teachers generally lack experience with inquiry-based instruction (Costenson & Lawson, 1986; Kleine *et al*., 2002; NRC, 2000; Windschitl, 2002) [40, 53, 91]. This lack of experience may lead teachers to believe that they are unable to teach inquiry-based instruction. Because beliefs have been shown to strongly influence teacher behavior (Bandura, 1977; Ghaith & Yaghi, 1997; Pajares 1992) [10, 11, 32, 56], they could play a major role in whether or not a teacher chooses to implement inquiry teaching and learning in the classroom. In fact, as Bandura (1997) asserted, if teachers "believe they have no power to produce results, they will not attempt to make things happen" (p. 3). Thus, if teachers do not believe they can teach inquiry-based instruction, they may not even attempt to try it. Unfortunately, all of these challenges may result in teachers promoting less effective traditional ways of teaching instead of promoting inquiry-based instruction which has been shown to be more effective for student learning (Costenson & Lawson, 1986; Lott, 1983; Wells, 1995) [24, 45, 89].

Current research shows that in many high schools, traditional teaching that emphasizes lectures and cookbook labs is still in place (Costenson & Lawson, 1986; Hurd, Bybee, Kahle, & Yager, 1980; NRC, 2000; Raloff, 1988) [24, 37, 53]. In fact, Raloff (1988) reported that "only about 40 percent are doing hands-on work on any given day" and of classes, "some 80 percent include lectures" (p. 166). As a result, students began to regard "science as a collection of facts to be memorized and explanations as reports of isolated events" (NRC, 2000, p. 118) [53].

Raloff (1988) also reported that "elementary grades are more likely to include hands-on training and less likely to involve lectures than either junior high or high school classes" and that "by high school, lecturing accounts for 43 percent of the class time - more than twice the time devoted to laboratory studies" (p. 166). This is alarming because inquiry-based instruction may be much more beneficial for student learning as compared to more traditional methods of learning such as lectures and cookbook lab exercises. It is also disturbing because current reform efforts, research, and legislation call for the implementation of inquiry teaching and learning.

In addition to the overuse of lecture, laboratory studies, when they are conducted, are not being done so in a manner that promotes higher levels of thinking (Backus, 2005). For example, "most high school chemistry labs contain detailed procedures on how to perform experiments, collect data, and analyze findings. These step-by-step instructions often eliminate opportunities for inquiry, higher levels of thinking, and the sense of accomplishment students find through independent discovery" (p. 54). During these step-by-step labs, "the problem is identified, and is obediently followed by a hypothesis: neatly an experiment is designed, and replication is only a matter of successful repetition before a conclusion issues forth. In the school classroom and laboratory this inevitably successful method takes precisely 40 or 50 minutes of the class period" (Brandwein, 1962, p. 115) Although this process may be tidy and predictable, it certainly doesn't allow students the opportunity to think critically about scientific phenomena or gain sophisticated understandings about science content.

These traditional methods may be effective for teachers in terms of time management and efficiency (Backus, 2005) but are not necessarily effective for students in terms of student learning and performance (Shymansky, 1984) [72], or "student attitudes, interest, learning, and intellectual development" (Costenson & Lawson, 1986, p. 156) [24]. Inquiry-based teaching, on the other hand, has been shown to lead to better student attitudes (1984), increased student motivation (Kleine *et al*., 2002; Wells, 1995) [40, 89], scientific knowledge growth and increased memory (Tamir, 1983) [76], and "significantly better performance when high levels of thought were considered" (1986, p. 150) [13]. In addition, traditional teaching methods do not "invite students to discover the limitations of present knowledge or identify unsolved problems and areas of present ignorance. Much less do they invite students to invent, to devise and explore possibilities alternative to current formulations" (Schwab, 1962, p. 39) [70]. Overall, the nature of science is ignored and student excitement and interest decrease.

As such, it is necessary to reform science teaching and move away from the traditional "unmitigated rhetoric of conclusions in which the current and temporary constructions of scientific knowledge are conveyed as empirical, literal, and irrevocable truths" (Schwab, 1962, p. 24) [70]. Implementing inquiry-based teaching transforms traditional classrooms full of memorized vocabulary terms and recited explanations into rich learning environments full of discovery. This, in turn, promotes better student performance (Costenson & Lawson, 1986; Lott, 1983; Wells, 1995) [24, 45, 89]. Inquiry-based instruction may require "experience on the part of teachers to engage students in supportive ways without interfering and it takes practice on the part of students to grow accustomed to the responsibilities and opportunities that occur when verification-based, cookbook laboratories are replaced by authentic inquiry learning experiences. However, the result is worth the effort" (McComas, 2005, p. 29).

Despite research highlighting the effectiveness of inquiry-based instruction, it still takes a back seat to traditional teaching methods in many schools today (Costenson & Lawson, 1986; Hurd, Bybee, Kahle, & Yager, 1980; NRC, 2000; Raloff, 1988) [24, 37, 53]. A major reason for this may be that teachers do not believe they can teach inquiry-based lessons (1980) and therefore do not attempt to teach it. Thus, one way to adjust the low priority of inquiry teaching and learning in high school science classrooms may be by investigating the self-efficacy beliefs of high school science teachers regarding the teaching of science as inquiry.

Self-Efficacy

Most of what is known about self-efficacy can be contributed to psychologist Albert Bandura. Bandura discussed self-efficacy in *Social Learning Theory* (1977) and defines it as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (1997, p. 3). Hence, using Bandura's ideas (1977) to examine the self-efficacy beliefs of high school science teachers regarding the teaching of science as inquiry may reveal information regarding the avoidance of inquiry-based instruction.

Bandura's *Social Learning Theory* (1977) asserts that "people fear and avoid threatening situations they believe themselves unable to handle, whereas they behave affirmatively when they judge themselves capable of handling successfully situations that would otherwise intimidate them" (p. 79-80). These judgments, which are "based more on what they believe, rather than on what is objectively true," effect how people approach situations (Bandura, 1997, p. 2). In general, "the stronger the efficacy expectations, the higher the likelihood that threatening tasks will be dealt with successfully" (1977, p. 85). When applying this idea to the teaching of science as inquiry, teachers who believe they are able to handle inquiry-based instruction and have high self-efficacy may view it as something to be mastered. Teachers who are unable to handle inquiry-based instruction and have low self-efficacy regarding inquiry teaching, are unlikely to use inquiry-based instruction because they may fear and avoid it (1977). Furthermore, these teachers are more likely to adhere to teaching strategies that they believe they can implement successfully even if those strategies are less effective.

Self-efficacy, as described by Bandura (1977), consists of two constructs: personal self-efficacy and outcome expectancy. The two constructs are "differentiated because individuals can come to believe that a particular course of action will produce certain outcomes, but question whether they can perform those actions" (Bandura, 1977, p. 79). Personal self-efficacy "is the conviction that one can successfully execute the behavior required to produce the outcomes" whereas outcome expectancy is defined as "a person's estimate that a given behavior will lead to certain outcomes" (1977, p. 79). "Bandura proposed that one's behavior is determined by both a general outcome expectancy (belief that behavior will lead to desirable outcomes) as well as a sense of self efficacy (belief that one has the requisite skills to bring about the outcome)" (Gibson & Dembo, 1984, p. 574) [33]

In addition, Bandura emphasized the "definition of self-efficacy belief as a situation-specific rather than a global construct" (Riggs & Enochs, 1989, p. 7) [63] Teachers' sense of efficacy has been shown to vary across different content areas, different grade levels, and different academic settings (Tschannen-Moran, Woolfolk-Hoy, & Hoy, 1998) [82]. Thus, teachers may "feel efficacious for teaching particular subjects to certain students in specific settings, and they can be expected to feel more or less efficacious under different circumstances" (1998, p. 227-228). Hence, "in making an efficacy judgment, a consideration of the teaching task and its context is required" in order to accurately assess the self-efficacy of certain teachers in particular situations (1998, p. 228).

Research has shown self-efficacy beliefs to be strong predictors of human behavior (Bandura, 1977; Ghaith & Yaghi, 1997; Gibson & Dembo, 1984; Guskey, 1988; Pajares, 1992; Singer, Marx, Krajcik, & Clay Cambers, 2000; Windschitl, 2002) [10, 32, 33, 35, 56, 73, 91]. Further, self-efficacy beliefs have been shown to be good predictors of teacher behavior in science classrooms (Bandura, 1986; Riggs & Enochs, 1990) [13, 23, 64]. Self-efficacy has also been linked to student achievement (Ashton & Webb, 1986; Armor *et al*., 1976; Berman, McLaughlin, Bass, Pauly, & Zellman, 1977; Gibson & Dembo, 1984) [4, 15, 33], teacher's willingness to implement new instructional techniques (Berman, McLaughlin, Bass, Pauly, & Zellman, 1977; Guskey, 1984; Rose & Medway, 1981) [15, 36, 67], positive attitudes about teaching (Guskey, 1984) [36], teacher stress, (Greenwood, Olejnik, & Parkay, 1990; Parkay, Greenwood, Olejnik, & Proller, 1988) [57], time spent teaching science (Riggs & Jesunathadas, 1993) [66] and the teaching of science as inquiry (Author, 2006; Author, 2008).

As a result, self-efficacy beliefs can affect whether or not a teacher chooses certain activities such as inquiry-based instruction. Bandura's *Social Learning Theory* (1977) may help to provide another explanation as to why teachers, despite the research highlighting inquiry teaching and learning, may choose not to include inquiry-based instruction in their lessons. It would be a worthwhile endeavor to investigate the self-efficacy beliefs of high school teachers in an effort to explain the low priority of inquiry teaching and learning in high school science classrooms.

Professional Development Programs

One way to gain the experiences necessary to alter teacher self-efficacy regarding inquiry teaching and learning may be teacher involvement with professional development programs. Because many of today's high school science teachers have not had the opportunity to experience inquiry-based instruction (Kleine *et al*., 2002; Tamir, 1983; Windschitl, 2002) [40, 76, 91], they may not believe they can teach it. Thus, they are less likely to implement inquiry-based instruction in their classrooms. Professional development programs could provide teachers with opportunities to experience inquiry-based instruction. Specifically, professional development programs could be useful for fostering change in teacher beliefs regarding the implementation of inquiry-based instruction which could, in turn, affect classroom behavior as well as student learning, achievement and interest. Hence, teacher involvement in a professional development program may be able to alter the self-efficacy beliefs of teachers.

Increases in self-efficacy beliefs from professional development programs could be beneficial toward the goal of implementing inquiry-based instruction in high school classrooms. Professional development programs can provide teachers with training, exposure to and experience with successful inquiry-based performances that may alter their self-efficacy beliefs toward inquiry teaching and learning. With exposure and experience with inquiry-based instruction such as from a professional development program, it may be possible to transform teacher beliefs regarding the teaching of science as inquiry. In fact, experience "in various stages of the process of inquiry" while "facing challenges such as 'unexpected results' or multiple answers might contribute a lot to inquiry-based science teaching" (Tal & Argaman, 2005, p. 389) [75] in regard to its implementation in high school science classrooms. The benefit of this would be that teachers gain experience and become more efficacious in regards to teaching science as inquiry. Consequently these teachers would be more likely to teach students through inquiry-based instruction which, as previously stated, is an effective learning strategy for all students. A professional development program aimed at increasing the self-efficacy beliefs of teachers may positively influence teacher self-efficacy beliefs.

One such program that could potentially influence teacher self-efficacy beliefs is the Science in Motion (SIM) program which focuses on improving science education and supporting high school teachers in Pennsylvania. As such, the purpose of this research was to investigate the effects of the Science in Motion program on the self-efficacy beliefs of high school science teachers regarding the teaching of science as inquiry. It must be noted, however, that SIM does not currently assert to make these changes. This research will examine both teachers who use and who do not use the SIM program, to determine the extent to which differences may exist in the self-efficacy beliefs of the participants in relation to the teaching of science as inquiry, which may influence the availability of inquiry-based instruction in the classroom.

Method

Purpose and Guiding Questions

The purpose of this research was to examine the effects of the Science in Motion (SIM) program on the self-efficacy beliefs of high school science teachers regarding the teaching of science as inquiry. Specifically, this study investigated the differences between the self-efficacy beliefs of SIM users and non-users. In selecting a measurement instrument for the data collection process of this research, it was important to consider validity and reliability. Hence, the Teaching Science as Inquiry (TSI) Instrument was chosen as our method of instrumentation, as it has proven to be a sound instrument when used to examine the self-efficacy beliefs of teachers regarding the teaching of science as inquiry.

Instrumentation

Although there are a number of instruments designed to measure self-efficacy, this study required an instrument that was specific to the purpose of the study, which was to measure the self-efficacy beliefs of high school science teachers regarding the teaching of science as inquiry. Because Bandura (1981) described self-efficacy as a situation-specific construct, this investigation required a situation-specific instrument that could be used to measure in-service high school science teachers' self-efficacy in relation to the teaching of science as inquiry. The TSI Instrument was developed "based on contemporary ideas about inquiry, as well as grounded in the fundamental ideas of Bandura, particularly the notion of self-efficacy being a context-specific construct" (Author, 2006, p. 141). The TSI Instrument addresses "the ideas of where self-efficacy and inquiry science teaching connect" (2006, p. 145) and thus, was situation-specific for this research to assess the extent to which the Science in Motion program effects the self-efficacy beliefs of high school teachers regarding the teaching of science as inquiry.

In addition to being situation-specific, the TSI Instrument also took into account Bandura's (1977) notion of the two constructs of self-efficacy: personal self-efficacy and outcome expectancy. The TSI Instrument, "which contained 69 Likert type items, modeled after those composing the STEBI A (Riggs, 1988) [65] and the STEBI B (Enochs & Riggs, 1990) [64, 23], was prepared with at least one item representation of both self-efficacy and outcome expectancy for each of the essential features of classroom inquiry and their variations" (Author, 2008, p. 293). This study intended to examine both constructs of self-efficacy as proposed by Bandura (1977) [10, 11]. Therefore, the TSI Instrument was an appropriate instrument in this regard. For more information on the validity and reliability of the TSI Instrument, refer to Author (2006) [6].

Although the TSI Instrument was originally designed for use with preservice teachers, it was not designed so specifically that it could not be used to measure the self-efficacy beliefs of inservice high school teachers. The TSI Instrument measures the self-efficacy beliefs of teachers regarding the teaching of science as inquiry as defined by the NRC, which can be applied across all levels of instruction (NRC, 1996) [52]. Thus, the TSI Instrument was a suitable instrument for this study.

Participants

Data were collected from inservice high school science teachers from central Pennsylvania. The Teaching Science as Inquiry (TSI) Instrument was administered to 75 high school science teachers in seven different counties. Fifty-six high school science teachers from the seven counties completed the TSI Instrument. From that group, forty-nine surveys were retained because they were fully completed. Overall, data was acquired from 28 male and 21 female participants. The participants taught physics, chemistry, biology, or a combination of these subjects. In addition, teacher experience ranged from under one year of experience to over 30 years of experience. Seventy-eight percent of the teachers have participated in the SIM program while 22% have not participated in the program. (See Table 1 and Table 2 for specific demographic data of the participants).

Table 1: Demographic Data for Science in Motion Users

	Male	Female	Total
Years' Experience			
0-9	8	7	15
10-19	2	9	11
20-29	6	2	8
30 +	4	0	4
Total participants	20	18	38
% of total participants	41	37	78
Content Area			
Physics, Chemistry, & Biology	1	4	4
Physics	3	1	4
Chemistry	5	7	12
Biology	9	6	15
Physics & Chemistry	2	0	2
Total participants	20	18	38
% of total participants	41	37	78

Table 2: Demographic Data for Science in Motion Non-Users

	Male	Female	Total
Years' Experience			
0-9	2	1	3
10-19	3	2	5
20-29	2	0	2
30 +	1	0	1
Total participants	8	3	11
% of total participants	16	6	22
Content Area			
Physics, Chemistry, & Biology	4	1	5
Physics	1	0	1
Chemistry	0	1	1
Biology	2	1	3
Physics & Chemistry	1	0	1
Total participants	8	3	11
% of total participants	16	6	22

Data Analysis and Results

This study utilized coefficient alpha (α), a measure of internal consistency, to examine the reliability of the participants scores (Author, 2008) [6]. The overall reliability scores in relation to self-efficacy were: SIM users alpha =.933 and SIM non-users alpha =.953. The overall reliability scores in relation to outcome expectancy were: SIM users alpha =.913 and SIM non-users alpha =.943. According to Isaac & Michael (1996), these results were highly reliable. These results are summarized in Tables 3 and 4.

Table 3: Reliability Results for Complete Self-efficacy and Outcome Expectancy of Science in Motion Users

	Total
Personal Self Efficacy	.933
Outcome Expectancy	.913
Reliability Analysis – Scale Cronbach Alpha	

Table 4: Reliability Results for Complete Self-Efficacy and Outcome Expectancy of Science in Motion Non-Users

	Total
Personal Self Efficacy	.953
Outcome Expectancy	.943
Reliability Analysis – Scale Cronbach Alpha	

Coefficient alpha was also used to determine the reliability of the participant's scores in relation to the two sub-scales inherent in the TSI Instrument: personal self-efficacy and outcome expectancy for the NRC's (2000) [53] five essential features of classroom inquiry. In regard to self-efficacy, the results revealed that all five of the essential features exceeded Cronbach's alpha standard of.7 as designated by Isaac & Michael (1996). The findings across these five essential features (2000) were

- Learner engages in scientifically oriented questions: alpha =.773 for SIM users and alpha =.809 for SIM non-users
- Learner gives priority to evidence in responding to questions: alpha =.731 for SIM users and alpha =.754 for SIM non-users
- Learner formulates explanations from evidence: alpha =.766 for SIM users and alpha =.829 for SIM non-users
- Learner connects explanations to scientific knowledge: alpha =.770 for SIM users and alpha =.890 for SIM non-users
- Learner communicates and justifies explanations: alpha =.825 for SIM users and alpha =.782 for SIM non-users

These results are summarized in Tables 5 and 6.

In regard to outcome expectancy, data indicates that three of the essential features exceeded the definition of Cronbach's alpha standard of.7 as designated by Isaac & Michael (1996). These features were:

- Learner engages in scientifically oriented questions: alpha =.747 for SIM users and alpha =.867 for SIM non-users
- Learner formulates explanations from evidence: alpha =.754 for SIM users and alpha =.770 for SIM non-users
- Learner communicates and justifies explanations: alpha =.819 for SIM users and alpha =.708 for SIM non-users

These results are also summarized in Tables 5 and 6.

The results also revealed that two essential features exceeded this standard for SIM non-users only. These features were:

- Learner gives priority to evidence in responding to questions: alpha =.753 for SIM non-users
- Learner connects explanations to scientific knowledge: alpha =.715 for SIM non-users

These results are summarized in chart form in Table 6.

Although the following data did not meet the stringent standard designated by Isaac and Michael (1996), "researchers (Nunnally, 1978; Sax, 1974) suggest that for first generation instruments, the standard of a Cronbach's alpha of.7 or higher should be relaxed to a standard range of.5 to.6" (Author, 2008, p. 294) [6]. As such, in this study, each of the five essential features exceeded this standard. The results for the remaining two features were:

- Learner gives priority to evidence in responding to questions: alpha =.664 for SIM users
- Learner connects explanations to scientific knowledge: alpha =.595 for SIM users

Due to the reliability results, the scores of the participants can be considered reliable because the reported Cronbach's alpha internal consistency results are consistent with established acceptable levels (Isaac & Michael, 1996; Sax, 1974; Nunnally, 1978). See Table 5.

Table 5: Reliability Results for Self-Efficacy and Outcome Expectancy for the Essential Elements of Inquiry of Science in Motion Users

Essential Element	**Self-efficacy**	**Outcome Expectancy**
Learner Engages in Scientifically Oriented Questions	.773	.747
Learner Gives Priority to Evidence in Responding to Questions	.731	.664
Learner Formulates Explanations from Evidence	.766	.754
Learner Connects Explanations to Scientific Knowledge	.770	.595
Learner Communicates and Justifies Explanations	.825	.819
Reliability Analysis – Scale Cronbach Alpha		

Table 6: Reliability Results for Self-Efficacy and Outcome Expectancy for the Essential Elements of Inquiry of Science in Motion Non-Users

Essential Element	**Self-efficacy**	**Outcome Expectancy**
Learner Engages in Scientifically Oriented Questions	.809	.867
Learner Gives Priority to Evidence in Responding to Questions	.754	.753
Learner Formulates Explanations from Evidence	.829	.770
Learner Connects Explanations to Scientific Knowledge	.890	.715
Learner Communicates and Justifies Explanations	.782	.708
Reliability Analysis – Scale Cronbach Alpha		

This study also examined the mean self-efficacy scores and standard deviations for all participants. The overall mean self-efficacy score among the high school science teachers that use SIM was 3.945 with a standard deviation of.37. The mean outcome expectancy for the same group of participants was 3.685 with a standard deviation of.41. The overall mean self-efficacy score among the high school science teachers that do not use SIM was 4.105 with a standard deviation of.46. The mean outcome expectancy for the same group of participants was 3.854 with a standard deviation of.52. These scores indicate that the self-efficacy and outcome expectancy scores were slightly higher for teachers who were not using the SIM program. These results are summarized in chart form in Tables 7 and 8.

Table 7: Mean Scores and Standard Deviation for Complete Self-Efficacy and Outcome Expectancy of Science in Motion Users

	Mean	SD
Personal Self Efficacy	3.945	.37
Outcome Expectancy	3.685	.41

Table 8: Mean Scores and Standard Deviation for Complete Self-Efficacy and Outcome Expectancy of Science in Motion Non-Users

	Mean	SD
Personal Self Efficacy	4.105	.46
Outcome Expectancy	3.854	.52

Discussion

This study examined the SIM program specifically to determine if SIM influenced inquiry-based teaching. This was accomplished by comparing the self-efficacy scores between SIM users and SIM non-users. The SIM program aims to encourage and improve science instruction and education in the Pennsylvania secondary schools in which it serves. To realize this mission, SIM provides local high school science teachers a van equipped with the latest technology and a trained certified secondary science teacher to assist in teaching the labs. SIM also provides professional development opportunities for teachers through summer workshops, as well as daylong seminars and dinner meeting activities during the academic year. In addition, these activities facilitate teacher networking and the development of new curricula across Pennsylvania. It has been shown that teacher efficacy may be enhanced through in-service training (Stein & Wang, 1988; Ross, 1994) and thus, it is viable to assume that teachers that participate in such activities may have higher self-efficacy. However, as the overall results indicate, teachers who do not use SIM actually demonstrated higher self-efficacy than SIM users.

In light of the results, it is important to recognize that while SIM can provide the necessary equipment, personnel, and support, it is not necessarily the case that teachers are using SIM's support to implement the most current reform strategies in their classrooms. In fact, many SIM teachers still utilize cookbook labs that are written by outside companies. As a result, SIM may actually be promoting the traditional classrooms where "science is taught as a nearly unmitigated rhetoric of conclusions in which the current and temporary constructions of scientific knowledge are conveyed as empirical, literal, and irrevocable truths" (Schwab, 1962, p. 24) [70] These ideals are in direct contrast with current reform efforts promoting the use of inquiry-based instruction which "allows students to conceptualize a question and then seek possible explanations that respond to that question" (NRC, 2000, p. xii) [53]. Through inquiry teaching and learning, students are asked to seek answers to questions by devising their own experiment rather than by following a step-by-step recipe. This "process of seeking answers to questions usually results in expanding students' understanding of a concept" (Llewellyn, 2001, p. 128) [43]. The notion of seeking answers to questions is more in line with the ideas of inquiry-based instruction. In sum, it seems that, despite the idea that SIM could provide support for teacher experience and practice with inquiry teaching, teachers are not utilizing the service for that purpose. This could be a future goal of SIM.

Conclusion

Although the findings of this research are valid and reliable, as with all research, there are issues that may require further examination. For example, it may be valuable to consider whether or not certain factors such as social desirability bias, influence response choices and therefore impact the validity of the TSI Instrument. Social desirability reflects "the tendency of people to deny socially undesirable traits and to 'admit' socially desirable ones"(Phillips & Clancy, 1970, p. 504). In this study, the social desirability bias would reflect the tendency of participants to indicate favorable habits regarding the teaching of science as inquiry rather than unfavorable teaching habits. Teachers may indicate that they agree with certain TSI Instrument items because they think they are desirable traits for teachers to have or traits that the researchers might consider appealing, even though anonymity was provided.

Another area of concern is the differing views associated with the magnitude of self-efficacy. This study has discussed the benefits associated with a higher sense of teacher self-efficacy. High teacher self-efficacy has been related to student achievement (Armor *et al*., 1976; Ashton & Webb, 1986; Berman, McLaughlin, Bass, Pauly, & Zellman, 1977; Gibson & Dembo, 1984) [4, 15, 33], teacher's willingness to implement new instructional techniques (1977; Guskey, 1984; Rose & Medway, 1981) [36, 67], positive attitudes about teaching (Guskey, 1984) [36], teacher stress (Greenwood, Olejnik, & Parkay, 1990; Parkay, Greenwood, Olejnik, & Proller, 1988) [57], time spent teaching science (Riggs & Jesunathadas, 1993) [66], and the teaching of science as inquiry (Author, 2006; Author, 2008) [5, 6]. However, there is a body of research that describes the value of teacher efficacy doubts (Wheatley, 2002). Specifically, Wheatley asserts that "teacher efficacy researchers may not have recognized the value of teacher efficacy doubts because they have focused on teachers' efficacy beliefs regarding their performance, rather than their efficacy beliefs regarding their ability to learn" (p.11). He suggested that there are "potential benefits of teacher efficacy doubts" and asserts that doubts may be essential for "teacher learning and educational reform" (p. 5-6). Thus, this theory may require further examination.

Implications

Several implications exist in this study. An area of study warranting further examination is to evenly balance the population of participants in the study. This research investigated a population where the groups were not equal: SIM users, 78% and SIM non-users, 22%. An evenly balanced population would contribute to the reliability of the study because simply stated, more participants make a study more reliable (Borg & Gall, 1989). This study still provides useful data, however, further research could be conducted on a population that is more evenly balanced in order to make the results more generalizable to all populations.

Another area of warranting further investigation is that research has shown that self-efficacy beliefs are much more malleable in the preservice years of teaching or in the beginning of a teaching career than they are for teachers with more experience (Bandura 1997; Tschannen-Moran & Woolfolk-Hoy, 2002; Tschannen-Moran & Woolfolk-Hoy,

2007) [14, 81, 80]. In fact, Bandura (1997) [14] suggested that once self-efficacy beliefs have been firmly established, they become resistant to change and would require significant attention to initiate reconsideration. With this in mind, researchers will need to further investigate factors that affect the self-efficacy beliefs of seasoned high school teachers and how it is established.

According to Bandura (1997) [14], self-efficacy beliefs are likely to be lower for teachers who rely a great deal on support. This could explain why the SIM users had lower self-efficacy as compared to the SIM non-users. This phenomenon is particularly true for teachers at the beginning of their career (1997). With this in mind, programs such as SIM would have to be cautious not to provide too much support for teachers early in their careers. Teachers could possibly learn early in their teaching careers to rely too much on support from programs. They could also become accustomed to relying on aspects of the program such as specific equipment use. This could be distressing to a teacher if the support on which they rely were ever withdrawn. Instead, if teachers learn to cope with the resources and support already available at their school, then a program such as SIM could be an excellent supplement to an already stable curriculum. It is important to note, however, that other researchers have reported that support and teaching resources during the first years of teaching are critical for the development of teacher efficacy (Tschannen-Moran & Woolfolk-Hoy, 2002) [81]. Because of the discrepancy in these theories, this area warrants further examination.

Researchers may also benefit from using other modes of data collection in conjunction with the TSI Instrument to more accurately represent teacher intention regarding their Likert-scale numeric answer to the question. Teacher interpretations of items gathered from interviews and observations may be more informative and accurate than those reported from a Likert scale instrument. Therefore, observations and interviews with participating teachers should be included with the TSI Instrument data collection technique to find any correlation between responses on the TSI Instrument and the use of inquiry-based instruction in the classroom.

Finally, it may be important for programs, such as SIM, to reorganize their curriculum to include more inquiry-based teaching and learning experiences rather than on cook-book labs. This is necessary because current research and reform efforts in science education highlight the benefits of inquiry-based teaching and learning. In addition, teachers who attend professional development programs or workshops aimed at inquiry teaching and learning would be able to experience inquiry-based instruction, which could thereby increase their self-efficacy. This could ultimately lead to an increase in the current priority level of inquiry-based instruction in high school science classrooms. Further, “the vision of science and how it is learned as described by the NRC in the Standards will be nearly impossible to convey to students in schools if the teachers themselves have never experienced it” (NRC, 1996, p. 56) [52]. Therefore, making experiences with inquiry-based instruction readily accessible to teachers may be worthwhile for attempting to encourage them to include inquiry-based teaching and learning opportunities for their students. When teachers are able to have constructive opportunities and experiences with inquiry-based instruction through professional development, a positive change in their beliefs regarding the teaching of science as inquiry may occur (Avery, Trautmann, & Krasny, 2003; Knox, Moynihan, & Markowitz, 2003; Lawrenz, 1984; Lott, 2003) [8, 42, 41, 46,]. This may lead teachers to implement teaching science as inquiry in their high school science classrooms. Mandated opportunities for teachers to experience inquiry-based instruction could help reform efforts related to inquiry teaching and learning to become a higher priority in high school science classrooms. In short, offering professional development to teachers may serve as a valuable approach toward reaching this goal.

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