

Inquiry Based Teaching Today Reflects the Moore Method

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December 2012

In the 1920's, Robert Lee Moore believed that he could learn mathematics best, by teaching himself, rather than being told what to do or shown a particular procedure. Moore decided to develop this self-teaching technique, as opposed to lecture, in his mathematics classrooms. In more recent years, this method is partially reflected in inquiry based teaching. Based on recent international testing, most of the students in the United States are not performing at a proficient level in mathematics. Furthermore, students in the United States cannot be competitive in mathematics with students from other industrialized nations.

Research Indicates a Need for Reform

Although the National Assessment of Educational Progress (NAEP) average mathematical scores have been gradually increasing over the past 20 years, the increases are not large. The National Center of Education Statistics (NCES) states that while mathematics scores are generally increasing, the United States, in comparison to the rest of the world, is not making enough progress to be competitive (NCES, 2012, para. 2). The Trends in International Mathematics and Science Study (TIMSS), is a rigorous and comprehensive international study of education with assessments since 1995 in mathematics and science. TIMSS administered an assessment in 2007 to students at the end of secondary school (NCES, 1999). The results from this TIMSS assessment represented content that is in the curriculum of approximately a seventh-grade level for most TIMSS nations. This content, however, was equivalent to the ninth-grade curriculum in the United States. Additionally, according to the TIMMS report for secondary students, the United States performed lower in both science and mathematics than other industrialized countries. These results did include the most advanced students from the United

States. Furthermore, in mathematics, the United States outperformed only South Africa and Cyprus of all TIMSS nations participating in the most recent assessment.

Program for International Student Assessment (PISA), another international assessment, claimed that among the thirty three countries participating in the 2009 assessment, seventeen of them scored significantly higher than the United States, while the United States only scored higher than five nations (NCES, 2009, para. 1). Those five countries included Israel, Greece, Turkey, Chili, and Mexico. In addition, PISA has a mathematical literacy proficient system in which they rank students internationally. This system is made up of levels, one through six, where one is the lowest mathematical literacy proficient, and six is the most advanced. In the United States, only twenty six percent scored at or above a level four, and twenty three percent scored below a level two, which means the majority of United States students scored at level two or three out of six (NCES, 2009, para. 2). These results should raise concerns for the United States, as well as create an urgency to find out ways in which the United States can improve their educational system and the mathematical proficiency of students.

Since the United States is not performing at the level of other industrialized nations, there is a necessity for change. The National Council of Teachers of Mathematics (NCTM) is “the global leader and foremost authority in mathematics education, ensuring that all students have access to the highest quality mathematics teaching and learning” (NCTM, 2012, para. 4). In the Principles and Standards for School Mathematics, NCTM (2012) emphasized how understanding mathematics is essential to everyone, as well as useful in daily life and in the workplace. This need to understand as well as be able to use mathematics, is increasing globally since we live in a time of constant change and instant knowledge transfer. Therefore, those who fully understand and can do mathematics will have magnified opportunities and options that could impact and

expand their futures. According to Principles and Standards for School Mathematics, NCTM (2012) emphasized that mathematical knowledge is vital for our students' future and will assist them in competing in the changing world.

The National Science Foundation (NSF) has funded numerous research programs designed to reform mathematics education. The intended goal of both NSF (2002) and NCTM (2012) is to create a coherent curriculum that will enable the students to be engaged in an environment full of well-constructed, worthwhile mathematical tasks. One pedagogical technique recommended by NCTM (2012) is inquiry based teaching and learning. The data provided by PISA and TIMSS emphasizes that changes are needed in mathematical education in the United States.

Inquiry, as defined in NCTM's *Mathematics Teacher*, is a technique that utilizes high-level tasks in student centered mathematics instruction (Smith, 2007, p. 560). In addition, this technique includes group work that allows and encourages "brainstorming, processes, discussion, and trial and error" (Chissick, 2004, p. 6). NSF (2002) describes elements of an inquiry based classroom, and furthermore states that these elements are generally absent from traditional mathematical instruction.

The basic elements, described by NSF (2002), for inquiry based classrooms include problem solving, analysis, active engagement, investigations, conjectures, and justifications. All these elements are meant to be integrated to have a successful inquiry classroom. Additionally, inquiry includes teaching practices such as, orchestrating group work, using good questioning and mediation techniques. Learning should occur in multiple ways and teachers need to continually assess students' progress. A major component of an inquiry classroom is class discussions where students share their results, and together construct new ideas for mathematics.

The majority of these elements, along with the given teaching practices, are absent in traditional classrooms.

A Pioneer of Inquiry

A pioneer of inquiry based instruction was Robert Lee Moore, who began teaching at the University of Texas in 1920. Moore once stated that “if someone would offer to take him by the hand and lead him through a forest to show him the birds and the animals, he would decline; he would rather take the time to find his own way through the forest” (Coppin, Mahavier, May & Parker, 2009, p. 12). Moore was captivated by the unknown and finding his own way, and wanted to orchestrate that his mathematics classroom. According to Coppin (2009), Moore is most famous for his teaching technique, which became known as the Moore Method. The Moore Method emphasized student responsibility for learning and creating mathematics, while reducing the need for teacher authority. This teaching concept was something new to the mathematics educational world, as well as the educational world at that time.

Charles Coppin (2009) described the Moore Method as similar to other pedagogies such as discovery based, inquiry based, and student centered. The Moore Method can be described as Socratic or constructivist, since this method “promotes valuable habits of mind akin to mathematical research and investigation” (Spesser, 2008, p. 3-4). As the instructor, Moore required students to work independently by arranging questions and theorems in a particular manner. Moore forced his students to depend entirely on their previous knowledge to gain mathematical truths. Instructors familiar with the Moore Method and the results of using this method, began to question the effectiveness of a strictly lecture based teaching method.

A major distinction between the Moore Method and inquiry based teaching is that teachers are an essential part of an inquiry classroom. Asking worthwhile questions is required of teachers in an inquiry classroom, thus compelling students to depend on their-existing knowledge. Additionally, the complexity of the question should push students to think critically and exploratory towards the problem at hand. An inquiry instructor facilitates learning in the classroom through posing meaningful questions requiring students to stay on task and establish a correct answer without being provided by the teacher. This is a major difference between inquiry learning and the Moore Method. Moore wanted to reduce the need for teachers to do anything other than create a collection of problems. NSF (2002) describes inquiry teaching as a catalyst to students' learning by creating a learning environment that consists of problem-solving situations that stimulate the students' interest, as well as critical thinking skills. This environment supports students in their attempt at solving the problems, as well as making sense of the mathematical concepts. As a teacher becomes more aware of inquiry classroom benefits they will understand the necessity of students making balanced and informed decisions about mathematics. Students learn how mathematics influences their lives and hopefully will employ their mathematical skills to solve other problems. The goal for inquiry teachers is to become a student guide, rather than a star performer; focusing, challenging, and encouraging student learning. The instructor plays a vital role in an inquiry based classroom, while teachers in a Moore Method classroom are not the center of student learning.

NCTM (2012) reinforces the awareness that procedures teachers use in the classroom are crucial. Students must learn mathematics with understanding, as well as continually building upon their previous knowledge. Students should be able to fully understand a given problem, devise questions about the problem, and find their personal direction or means of finding a

solution. Hopefully, the classroom should be an environment of “motivation, discovery, presentations, hunger, curiosity, and the delight of play” (Renz, 1999, para. 1). This is similar to the culture Moore wanted to establish in his courses. As contrasted with students in a traditional classroom, students in an inquiry class should learn what it means to do mathematics by gaining a different type of knowledge and a deeper understanding of mathematics.

The mathematics education in the United States needs to make some changes. A change might be achieved by inquiry based teaching, a method where students learn the value of original thinking, as well as teamwork and listening to their peers. Through inquiry, students learn and develop new strategies, gain the ability to question, hypothesize, reflect, and justify. Students are required to present their solutions and write mathematically. Inquiry could potentially create a better understanding of mathematics in the United States, which in turn, would help the United States compete against other industrialized nations.

It should be noted that more research is needed on inquiry based teaching. In 2006, the President of the United States ordered the Mathematics Advisory Panel to consolidate research on mathematical education and ways in which the education system could change. The Mathematics Advisory Panel published the final report in 2008, stating “recommendations that instruction should be entirely student centered is not supported by research” (National Mathematics Advisory Panel, (2008), pg. xxii). To compose the findings, the panel had strict and limiting qualifications for acceptable research. This resulted in very few studies considered for a the base of research for the report.

In conclusion, while inquiry based teaching is a good concept, more research on this method of teaching is recommended. The Moore Method is a forerunner of inquiry teaching and components of the Moore Method are incorporated in the inquiry based classroom. Robert Lee

Moore believed that mathematical understanding should not be given to students but the students themselves should create their own personal understanding of mathematics. Moore wanted students to be participants in their learning and knowledge acquisition rather than recipients of knowledge transfer. Moore's ideas on teaching and learning, as well as components of the inquiry learning should be considered in mathematics classrooms. However, more research on teaching techniques is needed in order to determine how to increase the level of mathematical knowledge of students in the United States.

Works Cited

- Chissick, N. (2004). Promoting learning through inquiry. *The Mathematics Teacher*, 97(1), 6-11.
- Coppin, C. A., Mahavier, W. T., May, E. L., & Parker, G. E. (2009). The Moore method a pathway to learner-centered instruction. Mathematical Association of America.
- National Center for Education Statistics.(1999). *Overview and key findings across grade levels*. Retrieved from <http://nces.ed.gov/pubs99/1999081.pdf>
- National Center for Education Statistics. (2009). *Mathematics literacy performance of 15-year-olds*. Retrieved from http://nces.ed.gov/surveys/pisa/pisa2009highlights_3.asp
- National Center for Education Statistics. (2012). *Digest of Education Statistics, 2011* (NCES 2012-001), [Chapter 2](#). Retrieved DATE from <http://nces.ed.gov/fastfacts/display.asp?id=514>.
- National Council of Teachers of Mathematics. (2012). *Mission, vision and priorities*. Retrieved from <http://www.nctm.org/about/content.aspx?ID=172>
- National Mathematics Advisory Panel. (2008). *Foundations for Success: The Final Report of the National Mathematics Advisory Panel*, U.S. Department of Education: Washington, DC.
- National Science Foundation. (2002). *Foundations. a monograph for professionals in science, mathematics, and technology education*. Retrieved from <http://www.nsf.gov/pubs/2002/nsf02084/start.htm>
- Renz, P. (1999). *The Moore method: What discovery learning is and how it works*. Retrieved from <http://legacyrlmoore.org/reference/FOCUS.html>
- Smith, B. (2007). Promoting inquiry-based instruction and collaboration in a teacher preparation program. *Mathematics Teacher*, 100(8), 559-564.

Spresser, D. (2008). The Moore method: viewpoint of a department chair. Retrieved DATE from http://legacyrmoore.org/reference/Spresser_handout.pdf