Stephanie Houts
CEP 822
Summer 2018
Research Review Paper

Introduction

In the field of education, there are researchers, educators, and administrators trying to better the field and introduce new methods and techniques. Among these, is the introduction of science, technology, engineering and math (STEM) education. There are many definitions of STEM in education, but Merrill (2009) defines it as "A standards-based, meta-discipline residing at the school level where all teachers, especially science, technology, engineering, and mathematics (STEM) teachers, teach an integrated approach to teaching and learning, where discipline specific content is not divided, but addressed and treated as one dynamic, fluid study." This idea of an integrated approach to these disciplines has been a popular topic, especially in the science education community. In this research review, the topic of STEM education is explored, specifically, the impact of STEM education on middle school and high school students.

Synthesis of Methods Used

There are many sources that analyze the effectiveness of STEM education and the current state of the curriculum across the country. There are also many methods used between the different studies. Through my research, about half of the studies were using data collected from other organizations and surveys. Several articles discussed the current state of STEM education and how it has changed since first being introduced in the K-12 system. There were articles that collected data from the National Science Foundation (Schneider, 2014), National Research Council (Moore and Smith, 2014), and many other articles used data collected from researchers who authored other articles.

A conscious effort was made to select articles that analyzed qualitative and quantitative data, since both types of data can shine light on different aspects of the impact of STEM education. Most of the qualitative data came from surveys given to students, parents and(or) teachers. These survey topics ranged from student engagement (Franco and Patel, 2017), teacher and administrator understanding of STEM education (Brown, Brown, Reardon, and Merrill, 2011), and the challenges that go into developing a quality STEM curriculum (Bybee, 2010). Some of the quantitative data was also collected using surveys that asked participants to rate their knowledge or feelings on the topic. There were also quantitative data collections that used student enrollment and interest level in STEM related classes and careers (Nathan et.all, 2013).

A common research question through many of the articles selected, addressed the challenges that teachers face when implementing STEM curriculum. Even though this subtopic wasn't necessarily the main focus of the study, it came up again and again. This is a telling fact, that even though STEM has been deemed an important topic in education and that all students should be able to participate in this integration of topics, it is a difficult curriculum for teachers to master.

It was also intriguing that there were fewer articles that included data from rural school districts. There were many articles that included research performed in inner city, suburban, and metropolitan areas, but few on rural districts. This may be because you can typically find a richer, more diverse group of students, families, and teachers in schools with larger populations.

Synthesis of Findings

One of the subtopics of particular interest for me was the analysis of student interest in STEM now versus when STEM first became a popular topic in science curriculum. After all of the hype of encouraging students to engage in curriculum and pursue a college education in science, technology, engineering, and mathematics, is there an increase in student interest in STEM and is the gap between male and female interest closing? This research question was addressed in several articles and overall, the gap is closing, slowly. The difference seems to be based on how the curriculum is introduced. One study focused on a specific curriculum, the Middle Schoolers Out to Save the World project (MSOSW) (Knezek, Christensen, Tyler-Wood and Periathiruvadi, 2013). In this study, results showed a positive growth in student STEM knowledge, perceptions of STEM, aspirations of STEM careers, and a huge growth of female interest in STEM. While this was only one project, the study addressed student engagement and the challenges that go into creating authentic STEM learning experiences and how, if done right, these experiences can create huge positive impacts when it comes to students and STEM. For every positive study done on STEM engagement and perceptions, there is one that shows negative correlations between STEM and career aspirations, or engagement. Bozick, Srinivasan, and Gotfried (2017) find that high school STEM courses are not benefiting non-college bound students when it comes to finding and advancing in STEM careers. Schneider (2014) found that the gap between male and female interest in STEM is still quite large based on the data collected. The link between these studies and the difference of results is again, the quality of professional development that teachers have when it comes to implementing and designing STEM curriculum.

The findings across all of the studies were not especially surprising. Based on the research conducted, students can gain skills in problem solving, critical thinking, communication, teamwork, and grit by participating in STEM activities throughout their K-12 school careers. The determining factor in whether the curriculum is effective or not comes down to how supported and prepared teachers are when they implement the curriculum. STEM doesn't have to be a stand alone class, in fact, by integrating STEM across multiple disciplines, students can gain a richer and more robust understanding of the content leading to higher engagement and effectiveness (Roehring, et al., 2012).

Implications for My Practice

As a science and STEM educator, this topic was very relevant for me. In order to give my students the most valuable and engaging experience with STEM content, I understand that it takes a lot of work on my end. By researching, joining professional learning communities, and participating in professional development, I can encourage my students to gain valuable 21st century learning skills that can benefit them well beyond their educational careers. I found some

incredibly inspiring articles that made me want to research methods further and better myself as an educator. After reading about the positive outcomes of lessons in Roehrig, et al. (2012) I am inspired to design different activities for my students. I also found the Knezek (2013) article motivating as they discussed how a program that was designed to place students in the center of the learning had given an empowering sense of creativity and confidence to the students involved. This is something I aspire to do in my own classroom.

Throughout my research on this topic, it was surprising to me to see the difference in results when it came to STEM engagement and middle school and high school enthusiasm when it came to STEM topics. Initially, I thought that engagement and enthusiasm must be at an all time high, based on my own experiences in the classroom. Though some studies showed that, there were just as many that showed the opposite. After analyzing the data, I came to the conclusion that it all depends on the curriculum and the activities and how they are implemented. I also understand that you will not gain the interest of all students, and that it is important to try to include all interests but to also know that you can't reach everyone. I feel that the information gained from this research will help me become a better educator.

Resources

- Brown, J. (2012). The current status of STEM education research. Journal of STEM Education : Innovations and Research, 13(5), 7-11. Retrieved from http://ezproxy.msu.edu.proxy2.cl.msu.edu/login?url=https://search-proquest-com.proxy2.cl.msu.edu/docview/1266493670?accountid=12598
- Brown, R., Brown, J., Reardon, K., & Merrill, C. (2011). Understanding STEM: Current perceptions. Technology and Engineering Teacher, 70(6), 5-9. Retrieved from http://ezproxy.msu.edu.proxy2.cl.msu.edu/login?url=https://search-proquest-com.proxy2.cl.msu.edu/docview/864940091?accountid=12598
- Bybee, R. W. (2010). Advancing STEM education: A 2020 vision. Technology and Engineering Teacher, 70(1), 30-35. Retrieved from http://ezproxy.msu.edu.proxy2.cl.msu.edu/login?url=https://search-proquest-com.proxy2.cl.msu.edu/docview/762467093?accountid=12598
- Daugherty, Jenny L.; Reese, George C.; Merrill, Chris
Journal of Technology Studies, v36 n1 p46-52 Spr 2010, https://eric.ed.gov/?id=EJ906160, 13 August, 2018.
- Duschl, R. A., Schewingruber, H. A., & Shouse, A. W. (2007). Taking Science to School: Learning and Teaching Science in Grades K-8. National Academies Press. doi:10.17226/11625

- Franco, M. S., & Patel, N. H. (2017). Exploring student engagement in STEM education: An examination of STEM schools, STEM programs, and traditional schools. Research in the Schools, 24(1), 10-30. Retrieved from http://ezproxy.msu.edu.proxy2.cl.msu.edu/login?url=https://search-proquest-com.proxy2.cl.msu.edu/docview/1973741455?accountid=12598

Stephanie Houts
CEP 822
Summer 2018
Research Review Paper

- Gomez, A., & Albrecht, B. (2014). TRUE STEM EDUCATION. Technology and Engineering Teacher, 73(4), 8-16. Retrieved from http://ezproxy.msu.edu.proxy2.cl.msu.edu/login?url=https://search-proquest-com.proxy2.cl.msu.edu/docview/1468440583?accountid=12598
- Knezek, G., Christensen, R., Tyler-Wood, T., & Periathiruvadi, S. (2013). Impact of environmental power monitoring activities on middle school student perceptions of STEM. Science Education International, 24(1), 98-123. Retrieved from http://ezproxy.msu.edu.proxy1.cl.msu.edu/login?url=https://search-proquest-com.proxy1.cl.msu.edu/docview/1509085408?accountid=12598
- Moore, Tamara J., and Karl A. Smith. "Advancing the State of the Art of STEM Integration." Journal of STEM Education : Innovations and Research 15.1 (2014): 5-10. ProQuest. Web. 9 Aug. 2018.
- Mueller, M., Tippins, D., & Bryan, L. (2012). The Future of Citizen Science. Democracy and Education,20(1). Retrieved August 08, 2018, from https://d2l.msu.edu/content/enforced/621372-US18-CEP-822-734-97J3Y8-EL-14-204/Mueller_The Future of Citizen Science_2012.pdf?_&d2lSessionVal=DhZhUF4LdI22NImV1dEwLKXJl.
- Nathan, Mitchell J., et al. "Building Cohesion Across Representations: A Mechanism for STEM Integration." Journal of Engineering Education 102.1 (2013): 77-116. ProQuest. Web. 9 Aug. 2018.
- National Research Council. 2015. Reaching Students: What Research Says About Effective Instruction in Undergraduate Science and Engineering. Washington, DC: The National Academies Press. https://doi.org/10.17226/18687.
- Robert Bozick, Sinduja Srinivasan & Michael Gottfried (2017) Do high school STEM courses prepare non-college bound youth for jobs in the STEM economy?, Education Economics, 25:3, 234-250, DOI: 10.1080/09645292.2016.1234585
- Roehrig, Gillian H., et al. "Is Adding the E enough? Investigating the Impact of K-12 Engineering Standards on the Implementation of STEM Integration." School Science and Mathematics 112.1 (2012): 31-44. ProQuest. Web. 9 Aug. 2018.
- Schneider, Madalyn R. "Middle School Students' Attitudes Toward Math and STEM Career Interests: A 4-Year Follow-Up Study." Order No. 3640858 Southern Illinois University at Carbondale, 2014. Ann Arbor: ProQuest. Web. 9 Aug. 2018.