STEM Education In The Elementary Classroom

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Abstract: The teaching of the integrated subjects of science, technology, engineering, and mathematics (STEM) is gaining importance in Grades K–12 in the United States (U.S.). STEM is viewed by many as an opportunity to collapse the teaching of these subjects individually by using a more interdisciplinary approach to learning. This paper will define STEM and provide a discussion of what does STEM look like at the elementary setting and why STEM is important in education in the U.S. today at the elementary level. Additionally, the paper will address to what extent the teachers teaching STEM at elementary level are getting the opportunities for their own professional learning to sharpen their STEM knowledge and teaching approaches, and how STEM can be implemented in schools, along with how STEM educators feel about integrating STEM subjects and do they integrate and apply them in the classrooms. Some people consider STEM as an opportunity while others view it as having problems. STEM offers some positive ways to integrate subject matter in four very important subjects, and how it is useful to incorporate STEM in the early years of education.

Keywords: STEM Education, Elementary classrooms,

Introduction

Early STEM education: A first-grade classroom, even your own. Kids gather around the sand table, exploring the sand, letting the grains run between their fingers. The teacher passes out some prop's marbles, rulers, boxes and cups and lets students explore freely for a few minutes. The kids excitedly dig in, filling cups with sand and pouring it out, burying marbles, and turning the rulers into shovels and rakes. Then she says: "I have a challenge for you today. How fast can you make the marbles roll?" Kids start rolling marbles across the sand, only to find the marbles quickly get stuck, hung up on miniature sand dunes. Then one student tries putting his marble on a ruler. It rolls much faster. Then another props his ruler up on a cup and the marble flies. The teacher watches quietly as the kids explore. Afterward, the teacher and her students gather on the rug to talk about their observations. She asks:

- "What did you design out of your tools that make the marble roll fastest?"
- "What do you think makes the marble slow down?"
- "Why do you think the marble rolls faster on the ruler than in the sand?"

Sand tables have long been a staple of early education. It is the way we plan a classroom activity and the questions we invite children to explore that turn an ordinary play activity into savvy and pointed STEM education. This teacher's methods are not only innovative, but also an essential segue into her students' future academic and professional success.

Why STEM in the early years?

STEM or science, technology, engineering, and math has become a big buzzword in educational circles in the last few years. However, our classrooms have not yet realized this potential as evidenced by a 2008 report, where in which the United States ranked 27th worldwide in math literacy and 20th in science literacy. Combine that with the fact that in US Department of Commerce research, workers in STEM fields earn 26% more than their counterparts and the job growth rate for STEM-related jobs is almost double that of non-stem occupations, and it is easy to see that STEM education is essential for the future economy not to mention to the kids' future success. By giving the kids tools they need to succeed in STEM, we are giving them a huge leg up as they enter the job market. But when we think STEM, we think middle school and high school, robotics, and chemistry not first graders and the sand table. Too often, STEM education begins with a disjoined introduction to engineering and technology concepts starting in middle school. And while any exposure to STEM is good, research study after research study on STEM education has shown that kids who experience STEM early through hands-on learning are the ones who will be best equipped to develop a strong understanding of STEM concepts as they get older. So how can you make STEM part of what your students do in the classroom every day? As an early education teacher, your plate is already quite full. The standards are there: with the advent of The Common Core along (*Common Core State Standards*. Washington, DC, 2010.) with the new Next Generation Science Standards (NGSS Lead States (2013). Next Generation Science Standards: For states, by states. Washington, DC: The National Academies Press.) teachers have access to solid, research-based curricular guidelines for STEM education. But the everyday tools and the practical age-appropriate lesson plans can be a bit harder to come by.

Methods

The purpose of this study was to determine what elementary school teachers think about the level of STEM education at the elementary setting.

A. Research Design

A descriptive, survey research design was chosen to investigate how all the four STEM disciplines are integrated and applied to solve real world problems, nature of STEM approach, use of technology in STEM, how students brainstorm, design, and create models to solve challenges together. More specifically it addressed the following research question: What does STEM look like at the elementary setting? The survey was designed based on the literature review done on STEM education at the elementary level, what is STEM literacy. The survey consisted of fifteen questions divided into three categories of questions RQ_1: Determine the classroom strategies and techniques used by the teachers to incorporate STEM in the classroom teaching which means at which level the students are involved learning and using STEM in the classroom? RQ_2 To what

extent the teachers teaching STEM at elementary level are getting the opportunities for their own professional learning to sharpen their STEM knowledge and teaching approaches? RQ_3: Do STEM educators feel that it is important to integrate STEM subjects, and do they integrate and apply them? The survey was administered using a self-administered approach where the survey was distributed among the participants. Upon receipt of the completed surveys, the data was studied and compiled for each survey statement, and then reported in a tabular form. Each table consists of four columns where first column describes the survey statement and different scales of a Likert-scale, the second column consist of number of responses with percentage of total responses of School 1 (Lemelson STEM Academy), third column consist of number of responses with percentage of total responses of School 2 (Coral Science Academy), and the fourth column consist of the total percentage of the number of responses with percentage of total responses of School 1 & 2 combined. Next average responses for each column were calculated and were used further to decide the final score/value of the responses based on the different scales of a Likert-scale survey developed (Strongly Disagree (value of 1), Disagree (value of 2), Agree (value of 3), or Strongly Agree (value of 4).

B. Design & Treatment

The research tool chosen for this study was a Likert scale quantitative survey, the quantitative research methods are used when researcher want to know "how many" and/or "how often", want to profile a target audience by determining what proportion of the audience has certain behaviors, behavioral intentions, attitudes, and knowledge related to the topic, and whether specific determinants predict behaviors at a statistically significant level (Qualitative Research Practice, 2003). Quantitative research involves Surveying a large group of people and using a structured questionnaire that contains predominantly closed-ended, or forced-choice, questions. Designing of quantitative survey includes considering issues related to designing an appropriate sample, using valid and reliable measures, and conducting a pretest before the survey study is launched. Most surveys are custom studies designed to answer a specific set of research questions. Surveys can be conducted face-to-face, by mail or telephone, or by computer. They can be self-administered or administered by an interviewer ((Qualitative Research Practice, 2003). Quantitative research tools such as survey can be useful when involves a convenience sample (e.g., a mall intercept study), data can be collected and analyzed quickly. When the survey involves a statistically valid random sample, the results from the sample can be generalized to the entire population if the response rate is high enough. Surveys can provide reliable (i.e., repeatable) direction for planning programs and messages and can be anonymous, which is useful for sensitive topics. Like qualitative research methods, surveys can include visual material and can be used to pretest prototypes (Mathers, Fox & Hunn, 1998). The results were reported based on the average response score for each survey statement separately which helped further to find out the answers for the research questions.

C. Population and Sample

The target population for this study was the 66 STEM elementary school teachers from two elementary schools in Reno, Nevada. The sample schools were selected based on the stage of the school education i.e., elementary school, and their focus on STEM education. The sample schools were STEM elementary school focusing on implementing STEM education at the elementary level. The targeted population was 66 but 33 teachers responded in total which means 50% population. The sample schools that were selected for the research were the elementary STEM schools in Reno, Nevada; School 1: Lemelson STEM Academy, and School 2: Coral Science Academy, total 66 teachers were administered out of which 23 were from Coral Science Academy, and 43 were from Lemelson STEM Academy.

D. Instrumentation

The survey designed to gather data from the population was a closed form, 4-point Likert-scale survey combined with an open form survey (Law, Types of Survey questions). The closed-form, Likert-scale questions were used to determine the level at which STEM is used in the elementary classroom by the teachers, science, technology, engineering, and mathematics are integrated and applied to solve real world problems, teaching approach used that involves kids in active engagement and hands-on investigation, time allotted for teaching STEM. This section also gauged how well these integrative methods aid students to succeed in the STEM education learning and develop higher order thinking skills. The open form question asked for biggest challenges faced in teaching or learning STEM. This section of the survey allowed teachers to share problems/challenges they came across while teaching STEM lessons, also methods and lessons they feel are successful. These questions were developed to answer the research questions, raised by the review of literature. See Appendix A.

E. Data Collection Procedure

To complete this study, the survey was created to collect the information from the elementary STEM teachers about what does STEM look like at the elementary setting. An Email was sent to the principals of two different STEM elementary schools explaining the topic of research and purpose of the survey. After getting the permission from the principal, the survey was distributed among the teachers at the respective schools. Upon receipt of the completed surveys, the data was studied and compiled, looking for significant indicators explaining the position of STEM education in elementary setting. Those results were then reported, and conclusions and recommendations were made. The findings were separated into two sections. The first was a tabulation and frequency analysis of the 15 Likert-scaled questions and the second was a synopsis of the responses to the open response questions. The problem of this study was to determine position of STEM education in STEM elementary schools, teachers' use of methods to integrate science, technology, engineering, and mathematics for improved student learning of complex ideas. The survey was distributed to 66 recipients of the two elementary STEM school teachers on October 17, 2016. The follow-up correspondence was sent via electronic mail and then by phone call. The data collection was completed between October 17, 2016, and November 10, 2016. Fifty percent of the population responded, which was 33 of the 66 elementary STEM teachers.

F. Data Analysis

The data collected from the close-form survey were analyzed using the average response score of responses for each question. The frequency analysis gave a depiction of the average response of the sample population. The information gathered from the open-form part of the survey was used to provide challenges faced by the teachers teaching STEM, strategies they used, and examples of STEM integration. These examples, along with the data from the close-form component of the survey, were used in the recommendations section.

Results

For the closed form, Likert-scale questions, 15 statements allowed the responders to choose one response. The Likert-scale allowed responders to choose Strongly Disagree (value of 1), Disagree (value of 2), Agree (value of 3), or Strongly Agree (value of 4).

Survey Statement 1 *I think science, technology, engineering, and mathematics are integrated and applied to solve real world problems and challenges in STEM lessons I teach.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	0 (0%)	1 (7%)	1 (3%)
Agree (3)	7 (37%)	11 (78%)	18 (55%)
Strongly Agree (4)	12 (63%)	2 (14%)	14 (42%)
Average Response Score	3.6	3.1	3.3

Figure 1: *Survey Statement 1 Demographics*

In Fig. 1, Statement 1 stated "I think science, technology, engineering, and mathematics are integrated and applied to solve real world problems and challenges in STEM lessons I teach." 14 of 33 strongly agreed with this statement (42%), 18 of 33 agreed with this statement (55%), 1 of 33 disagreed with this statement (3%). The mean of the response values for this statement was 3.3, indicating that STEM education teachers agree with this statement.

Survey Statement 2 *I think the engineering Design Process drives student thinking and decision-making as they work on the real-world challenge in my classroom.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	0 (0%)	4 (28%)	4 (12%)
Agree (3)	12 (63%)	7 (50%)	19 (58%)
Strongly Agree (4)	7 (37%)	3 (21%)	10 (12%)
Average Response Score	3.3	2.9	3.2

Figure 2: *Survey Statement 2 Demographics*

In Fig. 2, Statement 2 stated "I think the engineering Design Process drives student thinking and decision-making as they work on the real-world challenge in my classroom." 10 of 33 strongly agreed with this statement (30%), 19 of 33 agreed with this statement (58%), 4 of 33 disagreed with this statement (12%). The mean of the response values for this statement was 3.2, indicating that STEM education teachers agree with this statement.

Survey Statement 3 *Science and mathematics content within the STEM challenges are deep, grade-level appropriate, and applied in my school.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	1 (5%)	6 (43%)	7 (21%)
Agree (3)	14 (74%)	7 (50%)	21 (64%)
Strongly Agree (4)	4 (21%)	1 (7%)	5 (15%)
Average Response Score	3.1	2.6	2.9

Figure 3: *Survey Statement 3 Demographics*

In Fig. 3, Statement 3 stated "Science and mathematics content within the STEM challenges are deep, grade-level appropriate, and applied in my school." 5 of 33 strongly agreed with this statement (15%), 21 of 33 agreed with this statement (64%), 7 of 33 disagreed with this statement (21%). The mean of the response values for this statement was 2.9, indicating that STEM education teachers agree with this statement.

Survey Statement 4 *I use a student-centered, inquiry-driven, or project-based approach that involves kids in active engagement and hands-on investigation.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	0 (0%)	1 (7%)	1 (3%)
Agree (3)	4 (21%)	9 (64%)	13 (39%)
Strongly Agree (4)	15 (79%)	4 (29%)	19 (58%)
Average Response Score	3.8	3.2	3.5

Figure 4: *Survey Statement 4 Demographics*

In Fig. 4, Statement 4 stated "I use a student-centered, inquiry-driven, or project-based approach that involves kids in active engagement and hands-on investigation." 19 of 33 strongly agreed with this statement (58%), 13 of 33 agreed with this statement (39%), 1 of 33 disagreed with this statement (3%). The mean of the response values for this statement was 3.5, indicating that STEM education teachers agree with this statement.

Survey Statement 5 *My classroom provides a supportive, risk-free environment where failure is considered a normal step in the process of discovery.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	0 (0%)	1 (7%)	1 (3%)
Agree (3)	3 (16%)	5 (36%)	8 (24%)
Strongly Agree (4)	16 (84%)	8 (57%)	24 (73%)
Average Response Score	3.8	3.5	3.7

Figure 5: *Survey Statement 5 Demographics*

In Fig. 5, Statement 5 stated "My classroom provides a supportive, risk-free environment where failure is considered a normal step in the process of discovery." 24 of 33 strongly agreed with this statement (73%), 8 of 33 agreed with this statement (24%), 1 of 33 disagreed with this statement (3%). The mean of the response values for this statement was 3.7,

indicating that STEM education teachers strongly agree with this statement.

Survey Statement 6 *I use technology in STEM lessons as a tool to facilitate research, investigation and design.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	1 (5%)	4 (29%)	5 (15%)
Agree (3)	13 (68%)	9 (64%)	22 (67%)
Strongly Agree (4)	5 (26%)	1 (7%)	6 (18%)
Average Response Score	3.2	2.8	3.0

Figure 6: *Survey Statement 6 Demographics*

In Fig. 6, Statement 6 stated "I use technology in STEM lessons as a tool to facilitate research, investigation and design." 6 of 33 strongly agreed with this statement (18%), 22 of 33 agreed with this statement (67%), 5 of 33 disagreed with this statement (15%). The mean of the response values for this statement was 3.0, indicating that STEM education teachers agree with this statement.

Survey Statement 7 *I have access to and time allotted for collaborative professional learning to sharpen my STEM knowledge and teaching approaches.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	1 (5%)	11 (79%)	12 (36%)
Agree (3)	10 (53%)	3 (24%)	13 (39%)
Strongly Agree (4)	8 (42%)	0 (0%)	8 (24%)
Average Response Score	3.4	2.2	2.9

Figure 7: *Survey Statement 7 Demographics*

In Fig. 7, Statement 7 stated "*I have access to, and time allotted for collaborative professional learning to sharpen my STEM knowledge and teaching approaches.*" 8 of 33 strongly agreed with this statement (24%), 13 of 33 agreed with this statement (39%), 12 of 33 disagreed with this statement (36%). The mean of the response values for this statement was 2.9, indicating that STEM education teachers agree with this statement.

Survey Statement 8 *In my classroom students work successfully together in teams.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	1 (5%)	0 (0%)	1 (3%)
Agree (3)	5 (26%)	8 (57%)	13 (39%)
Strongly Agree (4)	13 (68%)	6 (43%)	19 (58%)
Average Response Score	3.6	3.4	3.5

Figure 8: *Survey Statement 8 Demographics*

In Fig. 8, Statement 8 stated "*In my classroom students work successfully together in teams.*" 19 of 33 strongly agreed with this statement (58%), 13 of 33 agreed with this statement (39%), 1 of 33 disagreed with this statement (3%). The mean of the response values for this statement was 3.5, indicating that STEM education teachers agree with this statement.

Survey Statement 9 *In my classroom students brainstorm together, design, and create models to solve challenges.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	0 (0%)	4 (29%)	4 (12%)
Agree (3)	8 (42%)	8 (57%)	16 (48%)
Strongly Agree (4)	11 (58%)	2 (14%)	13 (39%)
Average Response Score	3.6	2.8	3.2

Figure 9: *Survey Statement 9 Demographics*

In Fig. 9, Statement 9 stated "*In my classroom students' brainstorm together, design, and create models to solve challenges.*" 13 of 33 strongly agreed with this statement (39%), 16 of 33 agreed with this statement (48%), 4 of 33 disagreed with this statement (12%). The mean of the response values for this statement was 3.2, indicating that STEM education teachers agree with this statement.

Survey Statement 10 *In my classroom students test and evaluate their models' performance and make decisions for redesign.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	0 (0%)	6 (49%)	6 (18%)
Agree (3)	10 (53%)	7 (50%)	17 (51%)
Strongly Agree (4)	9 (47%)	1 (7%)	10 (30%)
Average Response Score	3.5	2.7	3.1

Figure 10: *Survey Statement 10 Demographics*

In Fig. 10, Statement 10 stated "*In my classroom students test and evaluate their models' performance and make decisions for redesign.*" 10 of 33 strongly agreed with this statement (30%), 17 of 33 agreed with this statement (51%), 6 of 33 disagreed with this statement (18%). The mean of the response values for this statement was 3.1, indicating that STEM education teachers agree with this statement.

Survey Statement 11 *In my classroom students use effective communication approaches when describing their challenge and justifying their results.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	1 (5%)	3 (21%)	4 (12%)
Agree (3)	11 (59%)	10 (71%)	21 (64%)
Strongly Agree (4)	7 (37%)	1 (7%)	8 (24%)
Average Response Score	3.3	3.1	3.1

Figure 11: *Survey Statement 11 Demographics*

In Fig. 11, Statement 11 stated "*In my classroom students use effective communication approaches when describing their challenge and justifying their results.*" 8 of 33 strongly agreed with this statement (24%), 21 of 33 agreed with this statement (64%), 4 of 33 disagreed with this statement (12%). The mean of the response values for this statement

was 3.1, indicating that STEM education teachers agree with this statement.

Survey Statement 12 *I think as a result of STEM, I get more time for teaching Science at my school.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	1 (7%)	1 (3%)
Disagree (2)	0 (0%)	5 (36%)	5 (15%)
Agree (3)	8 (42%)	6 (43%)	14 (42%)
Strongly Agree (4)	11 (58%)	2 (14%)	13 (39%)
Average Response Score	3.6	2.6	3.2

Figure 12: *Survey Statement 12 Demographics*

In Fig. 12, Statement 12 stated "*I think as a result of STEM, I get more time for teaching Science at my school.*" 13 of 33 strongly agreed with this statement (39%), 14 of 33 agreed with this statement (42%), 5 of 33 disagreed with this statement (15%), 1 of 33 strongly disagreed with this statement (3%). The mean of the response values for this statement was 3.2, indicating that STEM education teachers agree with this statement.

Survey Statement 13 *The STEM curriculum in my school is multidisciplinary and include lessons that are integrated (to include math, science, technology, and engineering).*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	2 (14%)	2 (6%)
Disagree (2)	1 (5%)	5 (36%)	6 (18%)
Agree (3)	12 (63%)	6 (43%)	18 (54%)
Strongly Agree (4)	6 (32%)	2 (14%)	8 (24%)
Average Response Score	3.3	2.7	3.0

Figure 13: *Survey Statement 13 Demographics*

In Fig. 13, Statement 13 stated "*The STEM curriculum in my school is multidisciplinary and include lessons that are integrated (to include math, science, technology, and engineering).*" 8 of 33 strongly agreed with this statement (24%), 18 of 33 agreed with this statement (54%), 6 of 33 disagreed with this statement (18%), 2 of 33 strongly disagreed with this statement (6%). The mean of the response values for this statement was 3.0, indicating that STEM education teachers agree with this statement.

Survey Statement 14 *My school provides teachers with professional development opportunities around STEM.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	0 (0%)	0 (0%)
Disagree (2)	2 (10%)	6 (43%)	8 (24%)
Agree (3)	8 (42%)	8 (57%)	16 (48%)
Strongly Agree (4)	9 (48%)	0 (0%)	9 (27%)
Average Response Score	3.4	2.6	3.3

Figure 14: *Survey Statement 14 Demographics*

In Fig. 14, Statement 14 stated "*My school provides teachers with professional development opportunities around STEM.*" 9 of 33 strongly agreed with this statement (27%), 16 of 33 agreed with this statement (48%), 8 of 33 disagreed with this statement (24%). The mean of the response values for this statement was 3.3, indicating that STEM education teachers agree with this statement.

Survey Statement 15 *Students in my school are regularly involved with math, science, engineering or career and technical education (CTE) competitions.*	School 1 No. of responses with percentage (x%) of total responses	School 2 No. of responses with percentage (x%) of total responses	Total
Strongly Disagree (1)	0 (0%)	1 (7%)	1 (3%)
Disagree (2)	1 (5%)	6 (43%)	7 (21%)
Agree (3)	12 (63%)	7 (50%)	19 (58%)
Strongly Agree (4)	6 (32%)	0 (0%)	6 (18%)
Average Response Score	3.3	2.4	2.9

Figure 15: *Survey Statement 15 Demographics*

In Fig. 15, Statement 15 stated "*Students in my school are regularly involved with math, science, engineering or career and technical education (CTE) competitions.*" 6 of 33 strongly agreed with this statement (18%), 19 of 33 agreed with this statement (58%), 7 of 33 disagreed with this statement (21%), 1 of 33 strongly disagreed with this statement (3%). The mean of the response values for this statement was 2.9, indicating that STEM education teachers agree with this statement. The survey also included one open-form question, asking the teachers for the biggest challenges they faced in teaching or learning STEM. The responses were studied, and many different challenges came out like time for planning, integrating STEM in the classroom setting, lack of materials or supplies, access, and provision of new and updated technology to use in the classroom, resources to find effective STEM lessons and materials, and time management. Out of which 4 said access and provision of new and updated technology to use in the classroom, 9 said resources to find effective STEM lessons and materials, 11 said time for planning, 7 said integrating STEM in the classroom setting, 12 said lack of materials or supplies, and 13 said time management. The data collected from the open-form question was a collection of the problems or challenges faced by the teachers teaching STEM at the elementary level. Some responses occurred frequently, but generally responses were varied and encompassing. The data from this chapter was used to reach conclusions and make recommendations to STEM elementary teachers and future teachers.

Conclusion

The problem of this study was to determine what STEM look likes at the elementary setting, in other words at what level the STEM education has been incorporated and integrated in elementary schools. The data collected from the survey was tabulated and treated to address each one of the research questions. RQ_1 was to determine the classroom strategies and techniques used by the teachers to incorporate STEM in the classroom teaching which means at which level the students are involved learning and using STEM in the classroom. This goal was addressed by survey Questions 4, 5, 6, 8, 9, 10 and 11. The data collected in these survey questions indicated that STEM education teachers agree that they are using student-centered, inquiry driven or project-based approach that involves active engagement of kids and hands on investigation. They also agree that they provide a supportive environment to the kids which help them to brainstorm,

design, create models, and redesign to solve challenges by working together. However, it seems like though they are focusing on using strategies for effective STEM teaching but not getting enough time and resources to use them and plan future instructions. RQ_2 was to what extent the teachers teaching STEM at elementary level are getting the opportunities for their own professional learning to sharpen their STEM knowledge and teaching approaches. This goal was addressed by survey Questions 7, 12 and 14. The data collected in these survey questions indicated that STEM education teachers agree that they are getting enough opportunities for their own professional learning to sharpen their STEM knowledge and teaching approaches. This showed that teachers saw the day-by-day discoveries in STEM education which made them realize the importance of updating themselves with the advanced technologies and strategies. RQ_3 is do STEM educators feel that it is important to integrate STEM subjects and do they integrate and apply them. This goal was addressed by survey Questions 1, 2, 3, 13 and 15. The data collected in these survey questions indicated that STEM education teachers agree that it is important to integrate STEM subjects and they do think science, technology, engineering, and mathematics are integrated and applied to solve real world problems and challenges in STEM lesson they teach as well as the STEM curriculum also includes lesson that are integrated.

Discussion

STEM education is active and focuses on a student-centered learning environment. Students engage in questioning, problem solving, collaboration, and hands-on activities while they address real-life issues. In STEM education, teachers function as classroom facilitators. They guide students through the problem-solving process and plan projects that lead to mastery of content and STEM proficiency. STEM proficient students can answer complex questions, investigate global issues, and develop solutions for challenges and real-world problems while applying the rigor of science, technology, engineering, and mathematics content in a seamless fashion. STEM proficient students are logical thinkers, effective communicators and are technologically, scientifically, and mathematically literate (Maryland State STEM Standards of Practice Framework). According to the research results, elementary school educators need to be generalists, being instructors of all content area topics. But when it comes to STEM, problems arise in that (1) they often do not feel comfortable teaching STEM related lessons and (2) national tests ask them to focus more on language arts and math (only the "M" of STEM). STEM education needs to be a priority long before a child reaches high school. Research documents that by the time students reach fourth grade, a third of children have lost an interest in science. By eighth grade, almost 50 percent have lost interest or deemed it irrelevant to their education or future plans. At this point in the K–12 system, the STEM pipeline has narrowed to half. That means millions of students have tuned out or lack the confidence to believe they can do science. Research documents that by the time students reach fourth grade, a third of children have lost an interest in science. By eighth grade, almost 50 percent have lost interest or deemed it irrelevant to their education or future plans. At this point in the K–12 system, the STEM pipeline has narrowed to half. That means millions of students have tuned out or lack the confidence to believe they can do science (Murphy 2011, *STEM Education–It's Elementary*, US News). I find this research to be both confusing and disappointing, in my elementary teaching experience with STEM, I discovered from my observations that elementary students:

- Elementary-age students love hands-on and interactive STEM activities. Kids have a natural interest and curiosity in exploring how things work.
- Given a student-centric instructional setting where students are presented with open-ended STEM problems, the kids easily jump into the activities, work together, and share ideas with one another.
- Elementary-age students express joy in doing the activities. They find them fun.

So the issue and the solution revolve around getting elementary age learners engaged and interested in STEM early and often; starting STEM development in early years at primary school would help to challenge the current belief among school children that these subjects were difficult and only led down a specific career path such as "being a scientist", when actually STEM subjects "open up a variety of career options." (STEM skills should be 'integrated across the curriculum, Telegraph UK). Recent research has recommended that every effort should be made to start as soon as children enter elementary school. Studies have identified the elementary years as the period when students form their interests in STEM identities and careers much earlier than many people probably believe to be the case. This is particularly important for science, which gets short shrift in many elementary schools. (Improving STEM Curriculum and Instruction: Engaging Students and Raising Standards, successfulSTEMeducation.org) Research in STEM learning over the past two decades has a lot to say about what makes for effective, engaging STEM education. Among the key factors: it capitalizes on students' early interests and experiences, identifies, and builds on what they know, and provides opportunities to engage in the practices of science and mathematics to sustain their interest. In other words, throughout their schooling, students should learn to investigate questions about the world that they come across in daily life, in much the same way that scientists and mathematicians do (*Improving STEM Curriculum and Instruction: Engaging Students and Raising Standards*, successfulSTEMeducatgion.org).

Limitations

Since it was not possible to survey all STEM elementary schools, this study was limited to the teachers in two STEM elementary schools, the targeted population was 66 but only got 33 surveys back which limited the response rate to 50 %. Based on the two institutions that chose to participate in the research study, the sample of teachers were selected and the small sample within the teachers' population limits the generalizability of the findings. The other limitation of this study was the 4-point Likert scale where the participants did not have the neutral option to reply. The third limitation was that the results were based on the teacher's perception who are still learning about STEM.

Recommendations

From this point, the participants depart on a journey by answering questions about the nature, integration, incorporating STEM in the classroom, and importance of learning STEM, providing insights for effective STEM education, and describing curricular approaches to integrating STEM in classrooms. Recommendations are made based on the results:

- Focus on integration: Combine two or more of the STEM disciplines so students can see the relationship among concepts.
- Establish Relevance: Help the students develop meaning through the application of STEM knowledge.
- Emphasize Twenty-First Century Skills: Help students develop the knowledge and skills they need for the contemporary workforce.
- Challenge your students: Provide projects, tasks, and activities that hold students' interest and challenge their understanding and abilities.
- Mix it up: Provide a variety of STEM lessons and activities for the students.

Questions for future research

What is STEM teaching and learning? What does it look like in different classroom settings?
What is STEM literacy?
What are the different interdisciplinary levels of STEM teaching?
How can an elementary teacher in a self-contained classroom begin to create STEM lessons and units?
How can a content-specific teacher work with others to connect the STEM disciplines with each other and with language arts, social studies, art, and music?
How will STEM help you do a better job of teaching the extensive ideas in the content areas and make the learning relevant for your students?
How does STEM teaching and learning promote twenty-first-century skills?
How can you help others in your district cross disciplinary boundaries to create a richer, more meaningful environment for students in your school and district?

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