

STEM hidden in elementary education: seeing the pattern or living the moment by experience

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This study aimed to examine elementary pre-service teachers' perceptions of STEM education through two open-ended questions. Fifty pre-service teachers volunteered to participate in this study. Results revealed that most of them thought STEM education would allow elementary students to acquire knowledge through discovery learning. This way, a STEM approach would let students to be creative about their own learning. This approach would also have a positive impact on students' self-confidence. However, some participants were concerned that STEM education could be confusing for students that are not interested in these fields. Findings of the study revealed that pre-service teachers' perceptions of STEM education was shaped by their experiences gained in science and mathematics education method courses as well as the courses they completed prior to entering a teacher education program. As a result, pre-service teachers' perceptions of STEM education should be acknowledged by teacher educators when integrative STEM approaches are used.

Keywords: pre-service teachers; elementary; STEM education

Introduction

The STEM acronym stands for science, technology, engineering and mathematics. This approach includes all the STEM disciplines and addresses the need for the greater diversity in the STEM professions (Bybee, 2010). Over the past decade, the need in the next generation of STEM professionals (e.g. engineers, health care workers, statisticians) increased due to change and improvement in the workforce. As a result, improving STEM education has been popular in recent years. Although high school mathematics teachers have the role of preparing the next generation of STEM professionals, students had very little idea about what individuals in STEM careers do for a living. In the same way, both pre-service and in-service teachers do not know or nor are prepared to teach using integrative approaches in STEM education unless they are enrolled in workshops, professional development seminars and/or elective courses related to STEM education. Research studies have been conducted with students, pre-service and in-service teachers focused on perspective, integrative approaches, and the use of STEM activities (Adams, Miller, Saul & Pegg, 2014). However, a number of research studies focusing on how we prepare the most influential STEM professionals of all, elementary pre-service teachers, are very few (Griffin, 2015). The importance of STEM education at elementary grade level is acknowledged since elementary school offers unique opportunities for integrative approaches to STEM education. At elementary grade level, teachers are required to teach mathematics and science courses that are a core part of the curriculum. These courses lay the foundation for future STEM learning. However, elementary teachers are unprepared to guide students on the path to higher-level success in STEM fields due to the fact that the Turkish Higher Education Council do not include teacher education programs that

focus on STEM education. Due to the reasons discussed previously in this paper, it is very important to examine elementary pre-service teachers' perceptions of STEM education since their views on teaching STEM fields would have a great impact on their students' learning. Therefore, this current study intends to examine elementary pre-service teachers' perceptions of STEM education.

Elementary Pre-service Teacher Education Program

All elementary teacher education programs at four-year universities have used a standardized curriculum prepared by Turkish Higher Education Council (HEC, 2007). The curriculum at the elementary levels is established based on three domains, content courses, education courses and pedagogy courses. The content domain includes mathematics, mathematics education methods courses, science and science education methods courses. These courses are designed to prepare elementary pre-service teachers' knowledge for teaching.

Method

Research design

In this current study, a qualitative research design was utilized to determine elementary pre-service teachers' perceptions of STEM education. In order to have a better understanding of their views on STEM education two open-ended questions were administered to pre-service teachers. Pre-service teachers were asked to write their responses and explain their reasoning about STEM education at the elementary grade level.

Participants

This current study was conducted with pre-service teachers who were enrolled in an elementary teacher education program at a university located in northwest part of Turkey. Third year elementary pre-service were informed about the purpose of this study. A total of 50 elementary pre-service teachers, 38 females and 12 males, volunteered to participate.

Data Collection Tools

In this qualitative study, data were collected through open-ended questions. These questions were:

1. Do you think STEM education can be used effectively in elementary grade level (1- 4)?
2. Do you think STEM education would be useful for students?

Data analysis

Thematic data analysis was utilized to have a better understanding of pre-service teachers' perceptions of STEM education.

Findings

In this research study, pre-service teachers' perceptions of STEM education were examined through two open ended questions. Results of the study revealed that most of the pre-service teachers thought STEM education would provide opportunities that allow students to acquire knowledge through discovery learning. An integrative STEM approach would let students be creative about their own learning. This approach would have a positive impact on students' self-confidence. A few of them were concerned about elementary schools' limited access to technology tools. These pre-service teachers were also worried about the possibility that STEM education could be confusing for students that are not interested in these fields.

As it can be seen in Table 1, fourteen pre-service teachers said a STEM integrative teaching approach can be used for effective teaching. Nine pre-service teachers thought STEM education could help students have a better understanding of problem solving as well as the problem solving process.

Table 1.

Themes	f
STEM can be used for effective teaching. These areas support one another. It could help students to develop better understanding of mathematical concepts.	14
STEM can be useful for 'problem solving' because it could help students to understand the problem solving process.	9

These findings revealed that twenty-three pre-service teachers considered integrative approaches useful for students to develop better understanding of mathematical concept and problem solving. Although pre-service teachers have completed courses to teach these subjects separately in methods courses, they were able to understand that these subjects support one another. They were also aware that students would develop a better understanding of the concepts through integrative teaching approaches.

Table 2.

Themes	f
Elementary grade levels provide opportunities for students to easier access to knowledge... elementary grade can be helpful in students' future studies. STEM education can support students to explore new things, like information.	2
STEM can be useful to support students' self-confidence by letting them to learn by using co-existing knowledge to construct new knowledge.	4
Children at elementary grade level are curious and willing to learn. Therefore, they can be taught using integrative approaches in STEM education.	2
STEM can help students to develop their self-confidence by letting them to solve problems related to real life. This way, they would be confident to solve mathematical word problems.	2

Two pre-service teachers thought elementary grade level would provide opportunities that would allow students to explore new knowledge through STEM education. Eight of them also indicated that a STEM integrative approach would improve students' self-confidence since the learning environment would help students to construct their own learning (See Table 2).

Table 3.

Themes	f
For STEM education what we learn at the university is not enough. We need to improve our teaching approach personally or we should have professional development courses to have better understanding of STEM education.	2

As it can be seen in Table 3, two pre-service teachers considered that the teacher education program is not enough for their preparation to use effective STEM education approaches. They suggested professional development courses for STEM education prior to entering classrooms as an elementary teacher.

Table 4.

Themes	f
Nowadays, children have easy access to technology. With technology, they could develop a better understanding of what they learn.	6
It could be useful if we make it more fun for students.	2

Table 4 represents eight pre-service teachers' quotes on STEM education. Two of them suggested that professional development courses focusing on STEM education would guide them to use effective strategies as well as integrative approaches in STEM fields. Eight of the pre-service teachers emphasized the importance of technology use. With the use of technology, they suggested that students would develop a better understanding of what they learn. As they suggested, learning would be more fun for students in technology supported learning environments.

Table 5.

Themes	f
STEM education is useful for the future career choices of elementary level. At early age, they would learn in what fields STEM is applied.	2

Only two pre-service teachers emphasized the importance of STEM education for students' future career choices. Learning as early as possible about STEM fields and jobs would guide students to make better future career choices for themselves (See Table 5).

Table 6.

Themes	f
Many schools do not have access to technology tools. Due to this reason, it would be difficult for students use this type of activities.	2
Teaching approaches might not be useful for those who are not interested in STEM fields.	
This approach could be confusing for students.	

Two pre-service teachers were concerned about elementary schools' access to technology tools. Three of them thought integrated teaching approaches might not be useful for those who are not interested in STEM fields. Others were also concerned that these approaches could be confusing for students

Discussion

This study showed that elementary pre-service teachers' perceptions of STEM education is shaped by their experiences gained in science and mathematics education method courses as well as the courses they completed prior to entering teacher education program. Since the courses are generally taught as separate subjects instead of through integrative approaches, most of the pre-service teachers are unable to see that these courses construct the foundation of STEM learning. Pre-service teachers' perceptions regarding integrative STEM approaches would affect their future students' attitudes towards STEM subjects and fields. Therefore, the most influential STEM professionals of all, elementary pre-service teachers should be acknowledged by teacher educators.

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