**STEM Education in KSA: Problems and Solutions**

**Introduction**

STEM education is an approach that includes the four pillars of science, technology, engineering and mathematics. It is defined as “the creation of a field based on the integration of knowledge from other fields into a new 'whole'” (Morrison, 2006; Sanders, 2009). When STEM education removes the boundaries between the four disciplines and integrated them into one single discipline, students developed the ability to integrate and treat the world as one.

Integrated STEM curricula and instruction provide societies with highly qualified scientists, engineers, engineers and mathematicians and propel these societies toward economic prosperity. Therefore, it is important to design well-designed integrated STEM curricula and train teachers to teach effectively (Harris & Felix, 2010; Rogers & Portsmore, 2004).

STEM education has emerged as one of the fastest growing areas of educational innovation worldwide. Unfortunately, while the program has been successfully implemented in most countries, it has not been successful in Saudi Arabia due to lack of clarity in the general description of what STEM means and its purpose and scope. In 2009, the Ministry of Education (MOE), in partnership with Obeikan Research Development Company, introduced a new math and science curriculum as an adapted series of science and math textbooks produced by American publisher McGraw Hill. The adapted curriculum seeks to create meaningful connections between students' lives and educational experiences by implementing new educational practices that include student-centered inquiry strategies and problem-based learning.

STEM education is also recognized as a way to enhance mathematics and science curricula. Despite global recognition of his STEM benefits in education, its application and educational practice remains limited (Czajka and McConnell, 2016; English, 2016; Tofel-Grehl and Callahan, 2016). ). For example, general science education may fail to develop and improve students' critical thinking skills. In addition, we follow a lecture-based teaching method that focuses specifically on accepting facts completely detached from context and meaning. However, these limitations are not only practiced, but are overcome by the most valuable problem-solving techniques in STEM education (Trueman, 2013).

Furthermore, Furner & Kumar (2007) point out that the use of integrated education increases opportunities for learners to have more stimulating experiences. It can also ensure student-centered learning and improve higher-level thinking and problem-solving skills (Bell, 2016; Stohlmann, Moore, & Roehrig, 2012; Ellis & Fouts, 2001; King, & Wiseman 2001). Similarly, Morrison (2006) argued that integrated STEM education can improve students' problem-solving, innovation, invention, and reasoning skills. Integrated STEM curriculum can improve student learning, but teachers find it difficult to transition to this type of integrated curriculum based on their experience with traditional preparatory programs.

**Literature Review:**

STEM education can be seen as ``a means by which teachers support constructivist approaches to learning in order to facilitate and support meaningful learning in their students'' (Becker and Park, 2011).

In their study, Kennedy and Odell (2014) identified several factors for successful implementation of quality STEM education and curriculum. The first element is a strict instruction on the science and mathematics curriculum. The second component is the integration of engineering and technology into the math and science curriculum. A third component is to encourage teachers to tend to ask questions during the survey. The fourth component is to create opportunities and expand the workforce for STEM educators and learners. Michelich et al. (2016), on the other hand, provided insight into the importance of developing student learning in various social science studies. It emphasizes that it tends to the study further emphasized the inclusion of STEM in the curriculum of K-12 students.

Zeidler (2016) focused on the sociocultural and social scientific aspects of STEM education. ElDeghaidy and Mansour (2015), on the other hand, investigated Saudi science teachers' perceptions of STEM education and its interdisciplinary nature. The results of this study demonstrate the need to develop a professional model to analyze the shortage of science teachers in relation to educational content that facilitates her adoption of STEM education in the classroom. A similar study was conducted by her Madani (2017), examining teachers' perceptions and teaching practices of science and mathematics curricula as a positive step towards implementing her STEM education in the Saudi Arabian education system. The findings indicate a degree of ambiguity regarding the concept of STEM education in the curriculum. Also, the Saudi Arabian Ministry of Education's new education strategy has been found to be equally effective in implementing STEM education.

**Challenges**

Challenges include pace/time, student understanding of content and process, scheduling issues, and district policy concerns.

A major challenge for educators in implementing this reform is developing the ability to teach an interdisciplinary curriculum.

The Kingdom of Saudi Arabia (KSA) does not currently have a long-term teacher training programme. Most of KSA's training and development programs for science and math teachers are too short, lasting less than a week.

Studies (CaSE, 2014; Dearing & King, 2006; Myers, 2006; Smith, 2011) indicate a perceived concern among teachers that students may prefer non-STEM subjects.

Regarding the difficulties perceived by the teacher, after six days of her STEM program, the teacher's concerns about teaching integrated STEM subjects appeared to decrease.

Saudi teachers, who had mandatory training credits that they had to obtain each year, discussed some of the negative aspects of the Ministry of Education's training program. Overall, the Ministry of Education's training programs have not met the needs of Saudi teachers for a number of reasons.

Teachers emphasized that the topics in the training program were repetitive and had nothing to do with their work.

Teachers are generally dissatisfied with the quality of teaching. Because it lacks educational practices, is too brief, and has little impact.

**Solutions**

Al Salami, Makela, and De-Miranda (2017) showed that short PD sessions help change teachers' attitudes towards teaching an integrated STEM curriculum.

Teachers' positive awareness and interest in teaching the STEM curriculum should be increased. Shifting teachers from specific disciplines to interdisciplinary curricula is a major challenge, and skills in teaching this kind of approach need to be improved in order to increase teachers' interest in teaching STEM education.

Attitudes, along with student performance, are one of the factors that influence a teacher's interest in teaching a particular subject.

Further vocational training measures must be organized on a regular basis.

There is an urgent need to improve the practical implementation of STEM education in Saudi Arabian schools.

Due to the lack of supporting research available in Saudi Arabia, further research is recommended to provide a coherent vision for new mathematics and science curriculum reform.

More regional studies ( (like Najran) should be sought.

In addition, it was found that there was little research on coherence between mathematics and science subjects in their respective curricula, and more research was needed to examine how curricular coherence affects students.

Introducing reformed teaching approaches and their teaching methods should be the focus of teacher training programs and workshops.

Additionally, due to a lack of understanding of inquiry-based education, the complexity of the approach, and its pedagogical importance to future educators and STEM professionals, the provision and research of inquiry-based STEM professional development is justified.

Agencies need additional investments to optimize interaction and collaboration among math and science teachers.

This could take the form of establishing an educational platform that would bring together curriculum developers, educators, and teachers to provide resources and reference sources for formulating best practices related to STEM reform in the Kingdom.

Furthermore, for the successful implementation of STEM education, there is a need to improve and facilitate coordination among teachers of different STEM subjects.

Implementing her STEM education in Saudi Arabia requires greater emphasis on organizing and developing inter-theme relationships within individual STEM subjects.

In addition, the development of professional development programs and workshops should be reframed according to educational needs and standards and should be as beneficial as possible to meet the aims and objectives of the new mathematics and science curriculum. .

There is a positive association between teachers' attitudes towards science and their individual effectiveness in teaching and choice of effective teaching strategies. Teachers can therefore teach STEM-related curricula more effectively if they see them as relevant to themselves and society.

Involving teachers in integrated STEM professional development can increase attitudes and interest in teaching this approach.

Students will be able to put into practice the knowledge and skills they have learned in a STEM context and use them to solve the problems ahead.

Teacher skills are improved through preparatory programs to enable them to be more attentive and responsive to rapidly changing educational trends, including the current emphasis on teaching interdisciplinary subjects. and the need to change attitudes.

Future professional development (PD) programs should focus on training science and mathematics teachers who specialize in all areas of science and mathematics to teach integrated STEM subjects.

A professional development (PD) program should continue throughout the year, not in short sessions. Short sessions have been shown to be less effective in changing teachers' attitudes towards teaching her integrated STEM curriculum.

PD (Professional Development) programs should be implemented in schools so that all science and mathematics teachers, rather than a limited number of teachers, can participate in the programs.

**Conclusion** There is an urgent need to improve the quality of science and mathematics education in Arab countries. The dire state of mathematics and science education presented above should encourage educators and policy makers to make the necessary efforts to improve education for current and future generations. Traditional approaches to educational reform in Arab countries have not led to improved student achievement, so new approaches must be used. With proper planning and implementation, STEM approaches can be implemented using locally developed and validated teaching materials, adapted to the needs of Arab students and Arab countries, and evaluated by well-informed researchers which may produce positive results in Arab countries. Moreover, successful adoption of STEM approaches requires not only teacher preparation but also changes in assessment and teaching methods. Borrowing approaches that have worked in the West are no guarantee of success in the Arab context. Indeed, it does not guarantee success in other contexts different from the original context in which the approach was initiated and applied. With the above conditions in mind, educators in schools and universities in Arab countries should strive to create an environment in which STEM-like innovations thrive and students are ready to live and work in 21st century.

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