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The degree practices for mathematics teachers STEM education

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Abstract

The study aimed to investigate the teaching practices for mathematics teachers based on science, technology, engineering and mathematics (STEM) in Jordan. Descriptive analytical approach was used through observing the teachers' teaching in accordance with STEM. The study sample encompassed 30 teachers of mathematics in Zarqa city who were chosen randomly. The study results showed there are seven behaviours performed by the mathematics teachers in a medium degree consistent with STEM, and 14 behaviours by low-grade mathematics teachers are consistent with STEM. The results also revealed that there were not any differences between those practices attributed to qualifications and years of experience variables.

Keywords: Mathematics teachers, science, technology, engineering and mathematics (STEM), scientific qualifications, experience.

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1. Introduction

The current era is characterised by rapid advances in science and technology, which resulted in the occurrence of crucial changes in life, and may be the most vivid of these changes is represented in the use of modern technologies in various domains of modern knowledge, and to escort with these methods, teaching methods and scientific should be developed to achieve knowledge unity and the idea of curriculum integration is among such ways of development. The considerable evolution of the science, math, technology and engineering in recent decades has obvious implications for human society.

The philosophy of science, technology, engineering and mathematics (STEM) is based on knowledge unity principle and its functional form, indicating that the educational situation will become a vast and extended pillar activity where barriers among science, math, technology and engineering will disappear leading to a significant impact in the development of educational programmes that based on this STEM (Briney & Hill, 2013; Hughes, 2009).

Perhaps STEM seeks to achieve the idea of an integrated education, which looks for providing and creating a learning environment in such a way to help learners enjoy and engage in integrative workshops among these sciences, and be enabled to develop their knowledge and skills to allow them to understand and take hold of the different science easily and through enjoying education (Harrison, 2011). The results of the research which was conducted by Baran and Maskan (2010), Muhaisin and Khaja (2015) Thomas and Williams (2010); Wang (2012) and Williams (2013) also showed the lack of seriousness concerning the application of science and mathematics standards in public education and poor attention to the integration of all domains scientific knowledge exposed by students, which in turn reflected on their performance and thus failing to realise what they learned as well as their career options for teaching STEM.

STEM concentrates on four academic and scientific fields namely; ‘Science, technology, engineering and mathematics’ and using them together in education. These are considered fields constitute an integral part of education in the competitive global market, thus STEM is not only a movement of reform but also focuses on following an interdisciplinary approach to prepare better generation of students who have the knowledge and skills in various domains of Science, technology, engineering and mathematics and thus offering graduates who are capable to engage effectively professions posed by STEM, and these disciplines and specialisations can be explained as follows (National Governors Association, 2009; Thomasian, 2011):

- *Sciences.* Includes knowledge, skills, scientific and creative thinking methods, decision taking, values and scientific trends.
- *Technology.* Entails scientific and engineering applications and computer sciences.
- *Engineering design.* Includes two major elements that achieve engineering design-centred learning, namely; providing principle base of technological culture in high school stage and preparing students to study engineering design in post high school stage.
- *Mathematics.* Encompasses teaching broad basics and spectrum of mathematics fundamentals as well as mathematical problem-solving.

Furthermore, many studies have shown that STEM trend improves teaching–learning process, including the study conducted by (Hartzler, 2000) which proved effectiveness of science teaching programmes using the integrated curriculum in student’s achievement, as evidenced also the studies carried out by Baran and Maskan (2010), Han, Capraro and Capraro (2015), Jensen and Sjaastad (2013), Kaldi, Filippatou and Govaris (2011), McClain (2015), and Smith, Rayfield and McKim (2015) which emphasised the great benefit offered by STEM for students’ motivation, trends and the various skills required by the labour market as well as in increasing their achievement.

STEM aims to create the integration among science, math and technology, through the geometrical thinking, and make them tools for knowledge, through practical experience related to trial and error.

In the field of science; we are talking about describing the world, including its phenomena and discoveries, and we display this description in geometrical style to transfer and analyse it easily, while engineering contributes to change the world through applied perspective depending on both science and mathematics. Learning through STEM stimulates creativity among students through this linkage system, and it makes the teacher understand the importance of access to scientific language that suits the students' age and according to their way of thinking. STEM is applied through practical activities that will make the results more understandable and perceivable since they are concrete and tangible. Additionally, this style of education becomes more important as a balance tool between motivating the students to learn by using trial and error principle and providing them with basic skills of knowledge or scientific material to learn effectively (Jabr, 2015; Marginson, Tytler, Freeman & Roberts, 2013).

Moreover, STEM aims to create stimulating learning environment that increases students' self-confidence and linking such environment with their reality to encourage them to carry out investigative and explorative activities through stimulating their motivation and trust in learning science and mathematics through using technology, innovation and engineering design, thus making the learning environment full of experiences and piratical activities to reduce school students' absenteeism from school and this STEM also aims to disseminate scientific and technological culture among community members as well as students' acquisition of various thinking skills (Williams, 2013).

Therefore, the STEM endeavours to improve students' comprehension and acquisition of practical skills and scientific thinking and to increase their academic achievement through a number of procedures including the development of digital learning materials to support teaching–learning process, develop the teachers' capacities and enable them to teaching more efficiently, to establish virtual and traditional science laboratories, expand the opportunities for scientific knowledge and mathematical skills application, build positive trends through scientific exhibitions and competitions. Currently, this initiative is focusing on professional development programmes through global partnerships with leading organisations and universities in the field of science and mathematics education, the establishment of scientific centres as well as building digital content to support teaching–learning process (Shaughnessy, 2013).

STEM requires a teacher who has experience in dealing with materials used in activities and projects that necessary to learn as well as the ability to convert these materials and raw materials to the perceptible construct that students can benefit during their study, to have the spirit of innovation, invention and development. STEM confirms the need to provide necessary material and tools to carry out for various projects and activities by providing a range of technical and engineering programmes that help the teacher communicate with his students to explain how to deal with such materials as well as academic laboratories that assist in the delivery of the basic principles of science and theories to students who have to define them in order to realise the nature of link between these theories and principles of implementation of the project or scientific activities scientifically and soundly. Then students do not lose their scientific identity and significance of the implementation of projects, and in turn, the students will not become a tool to implement the project in a professional manner that is far from scientific principles (Sharkawy, Barlex, Welch, McDuff & Craig, 2009).

The studies conducted by Baran and Maskan (2010) and Muhaisin and Khaja (2015) indicated that in accordance with the STEM, teachers should master the way managing groups of students in parallel to achieve the ideas of various projects and accept all the ideas of these projects and not underestimate any idea and they should have scientific engineering and technical preparedness and readiness to discuss those ideas and highlight the extent of implementation or difficulties that prevent their implementation, as well as giving reasons through discussing or by searching in different references or via the Internet, composition workshops to discuss these projects seriously through many facets including economic and technological aspects or discussing the validity of such scientific ideas and offering advice and counselling to students concerning access to materials and their locations that are necessary for the implementation of these projects.

Moreover, in accordance with STEM, teacher should have the ability to instil geometric thinking among students and spotlight the importance of engineering design, which begins with the idea of the project and then to discuss it with a group of students as well as to encourage students through using brainstorming method, to hear their views, according to their viewpoints to implement of the project, as well the various ways to implement stereo or a model of the project, to conduct initial tests for the implementation of the final project. Teacher should also help the members project in the preparation of the initial reports, and how to prepare for the project paper, and finally train the group on how to view the project and train them on various presentation skills. Teachers' roles are not restricted with students only but their roles extended to cooperate with other teachers who teach various subjects and domains, to create and to find ideas and activities to help them communicate and deliver scientific principles and theories necessary for students (Ambo Sa'idi, Al-Harthy & Aashameh, 2015; Baran & Maskan, 2010; Muhaisin & Khaja, 2015).

Many studies have also recommended the need to increase awareness about STEM, the study carried out by Muhaisin and Khaja (2015) focused on the importance of professional development of teachers of mathematics and science by building a proposed perspective that focused on increasing awareness of that STEM. Furthermore, the study conducted by Ambo Sa'idi, Al-Harthy and Aashameh (2015) stressed the need to hold courses and workshops for teachers of mathematics and science to raise awareness on STEM.

This study reveals that there are gaps, ranging from high to medium in terms of the absence of educational policies and legislation, and national plans to teach in accordance with STEM and the lack of formal education to teach STEM in the Kingdom of Jordan so far, and the weakness of students' achievement and performance in mathematics and science nationally and internationally according to their results as well as the absence of professional development programmes to teach STEM. As confirmed by previous literature such as the studies conducted by Ambo Sa'idi, Harthy and Ashameh (2015), Baran and Maskan (2010), Muhaisin and Khaja (2015), Thomas and Williams (2010), Wang (2012) and Williams (2013) it is very crucial to pay more STEM, and in light of the scarcity of studies which addressed STEM, specially Arab studies that tried to study STEM—according to researcher's knowledge—and the active role of the teacher in the implementation of STEM in science and mathematics teaching in public education schools. Therefore, this study endeavours to investigate the degree of STEM implementation by teachers of mathematics in their teaching practices.

The importance of this study stems from the increasing interest STEM, which calls researchers for spotlighting STEM in terms of its ideas for realising developmental programmes that are derived from STEM, and invite to participate in gaining knowledge at least effort and time as well as to deploy it and make use of its applications, mainly in the field of Information and Communication Technology. The study is also very crucial since it directs the attention of those who are in charge of preparing and authoring mathematics curricula as well as those who shoulder the responsibility of teachers' training, taking into account the vital importance of STEM and this study may be the starting point for further descriptive or empirical studies in the future in the field of integrating the use of STEM in teachers' instructional practices.

1.1. Problem statement

The student's perception and understanding of the STEM orientation requires well-informed teachers and practitioners to be able to achieve the educational needs of students effectively. Those interested in STEM believe that the more the mathematics teachers understand the nature of science, technology, engineering and mathematics integration, the more they will reflect on their teaching performance. Thus achieving the objectives of teaching mathematics better. In light of the global trend towards the use of STEM in the teaching of mathematics, and in light of the absence of any Jordanian study in the subject, this study was conducted to investigate the degree of the practice of mathematics teachers teaching according to STEM, by answering the following questions

- What are the degree practices for mathematics teachers STEM?
- Does the degree practice for mathematics teachers STEM differ according to their qualifications and years of experience?

2. Methodology

Descriptive analytical methodology was used in observing the performance of a sample of mathematics teachers to know the degree of their practice of STEM education: It is an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering and mathematics in contexts that make connections between school, community, work and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy (Gerlach, 2012). In this study, STEM can be defined: the approach where science, technology, engineering and mathematics can be combined and to link them with the real-life situations of the students).

2.1. Study members

It consisted of all teachers of mathematics who teach high stage in Zarqa and 10 schools were chosen randomly out of which the study sample of 30 teachers of mathematics was formed during the second semester of the scholastic year 2016/2017, and Table 1 demonstrates the characteristics of the sample.

Table 1. Distribution of the study sample individuals of teachers of mathematics according to qualifications and experiences

Statement		No.
Scientific qualification	Bachelor	19
	Graduate studies	11
Experience	Less than 5 years	10
	5–10 years	13
	More than 10 years	7

2.2. Instrumentation

To achieve the objectives of the study an observation card was prepared in accordance with the following procedures:

1. The aim of the observation card was to investigate the practice degree of teaching requirements in accordance with STEM and the effect of qualifications and years of experience in such practice. *The practice Degree mean:* Everything that is conceived and carried out by the teacher and is considered suitable to apply STEM during teaching process which can be measured through using observation card with two scales (practice, do not practice) to know the degree practices for mathematics teachers (STEM education).
2. To prepare the observation card and its items, previous literature was used including (Ambo Sa'idi, Harthy & Ashameh 2015; Baran & Maskan, 2010; Muhaisin & Khaja, 2015) as well as the viewpoint of experts and specialists in the field of mathematics curricula and methods of teaching were put into consideration.
3. The observation card included the following data: school's code, teacher's code, qualification and years of experience, study unit, class, subject, date, mathematical content, teacher's movements and notices.

4. Twenty-one behavioural items were prepared and they were observable and measurable through observing teacher's conduct in the classroom. The observation card was designed through using dual rating that expressed teachers' practice of teaching behaviours in accordance with STEM so

that the card was filled by 'Yes' if the behaviour occurred and 'No' if it did not and these two ratings were presented numerically 1 and 0, respectively. To ensure the reliability and validity of the observation card, it was presented to the specialised arbitrators to give their viewpoints and ideas about items expressing mathematics teachers' practice of STEM, in addition to giving them full freedom to make addition, deletion or modification in the observation card. No amendments or changes were made concerning the items included in the observation card. Finally, the final version of the observation card was prepared out of 21 items. Furthermore, the observation card was applied on the sample which consisted of 17 mathematics teacher then the internal consistency coefficient was calculated through using Cronbach's alpha equation which scored 0.87 and this value was considered acceptable for scientific research purposes.

5. Data collection and analysis by using the observation card: After obtaining approval of 30 to carry out class observation, two class periods were observed for each teacher. Through attending the recorded class period for each teacher separately, two observation cards were filled in for each teacher. The first observation card was filled by the researcher while the other one by his colleague who watched the recorded class period. All the observation cards were filled with independently since the researcher and his colleague observed the class period separately to verify the extent of consistency between the estimations of the researcher and his colleague, which showed teacher's behaviour in the implementation of teaching requirement in accordance with STEM on the level of each class period. Coefficient of concordance between the two estimations was 0.93, and Copper's equation was used and it scored 0.90. To analyse the collected data through the observation card, arithmetic means and standard deviations were calculated for the observers' estimations concerning the degree of practice for each class behaviour listed in the observation card and the maximum and minimum scores for each behaviour were 1 and 0, respectively.

3. Results

3.1. What are the degree practices for mathematics teachers STEM?

A sample of 30 mathematics teachers' practices in different class environments as per STEM was observed, and long interviews were also held with teachers to complete the observation process for the researcher's understanding of the teaching practices. Table 2 illustrates the analysis of the items included in the observation card arranged descendingly.

Table 2. Means, standard deviations of mathematics teacher's practice of STEM

No.	Behaviour	*M*	SD	Practice degree
1	Using investigation, exploration and problem-solving strategies in teaching mathematics	0.55	0.51	Moderate
2	Using teaching activities which enable students to develop their mathematical and scientific skills	0.50	0.44	Moderate
3	Encouraging students to think about certain problem or situation comprehensively	0.45	0.50	Moderate
4	Providing opportunities to students to investigate, explore, design and implement solutions	0.42	0.40	Moderate
5	Providing opportunities to students in order to innovate and develop their mathematical experience	0.40	0.50	Moderate
6	Enriching mathematics curricula with subject that stimulate questioning about natural phenomenon and scientific discoveries	0.37	0.49	Moderate
7	Developing students' social and teamwork skills including collaboration, exchange of purposeful dialogues among them	0.37	0.50	Moderate
8	Developing student's tendencies and attitudes towards scientific and vocational specialisations	0.32	0.42	Low

9	Presenting mathematical subjects and themes as a way of thinking and problem solving	0.30	0.47	Low
10	Linking technology with mathematical subject and themes and using it practically.	0.30	0.50	Low
11	Combining scientific concepts, mathematical, technological and engineering knowledge consistent and integral context.	0.28	0.40	Low
12	Providing technological means and suitable tools to combine STEM interactively	0.27	0.45	Low
13	Training students on scientific research, experiments design and data processing	0.27	0.48	Low
14	Introducing STEM to students	0.26	0.52	Low
15	Developing special teaching materials related to STEM such as digital simulation programmes and videos.	0.23	0.40	Low
16	Enabling students to build their knowledge and employing them practically	0.23	0.43	Low
17	Linking scientific knowledge with future careers.	0.21	0.41	Low
18	Enabling students to understand the world and its problems integrally and impartially	0.20	0.45	Low
19	Establishing teaching–learning partnerships with students to foster their learning in the field of STEM	0.17	0.38	Low
20	Applying engineering design and technology principles in mathematics teaching strategies	0.10	0.31	Low
21	Using computer software in mathematics teaching	0.07	0.25	Low

Because of using dual scale in the observation card where one score is given to each item practiced by the teacher and zero score for unpractised ones, the highest arithmetic mean is 1. To explain teachers' practice of STEM in their teaching process considering the scale the following scale was adopted: [(high practice degree: 0.66 and more)—(moderate practice degree: 0.33–0.65)—(low practice degree: 0.33 and less)]. Therefore, Table 2 clearly shows that the arithmetic means for the mathematics teachers' practice ranged between 0.55 and 0.07, indicating that their degree of practice of STEM ranged between moderate and low degree.

Furthermore, Table 2 shows that mathematics teachers' degree practice of items (1–7) of the observation card were moderate respectively: using investigation, exploration and problem solving strategies in teaching mathematics; using teaching activities which enable students to develop their mathematical and scientific skills; encouraging students to think about certain problem or situation comprehensively; providing opportunities to students in order to investigate, explore, design and implement solutions; providing opportunities to students in order to innovate and develop their mathematical experience; enriching mathematics curricula with subject that stimulate questioning about natural phenomenon and scientific discoveries; developing students' social and teamwork skills including collaboration, exchange of purposeful dialogues among them.

The results of these items reflect the ability of some teachers to provide class environment for their students to attract their attention and prepare them psychologically and mentally to solve mathematical problems and develop their mathematical thinking. The researcher attributed this result to mathematics teachers' interest in using investigation and exploration and problem solving in mathematics teaching as one of their fundamental duties despite the weak figure; nevertheless, a few of them were interested in the exploration and inquiry and problem solving in mathematics education, which led to score this percentage. This result can be attributed to a lot of math teachers' lack of interest in encouraging students' comprehensive thinking, providing opportunity to foster their creativity and develop their expertise in mathematics. The researcher attributed this result to teachers' lack of knowledge of teaching requirements as per STEM and that they did not read suitable and recent literature that addressed STEM.

Table 2 also shows that teacher's practice of items (8–21) of the observation card were low due to mathematics teacher's interest in planning of teaching activities for the learning content through using traditional means where most of the teacher included in the sample dealt with planning as formal and was done to satisfy the requirements of the school administration only and that it was not important to prepare their lessons regularly in advance since such plan were accessible and ready via the Internet, through fixed contents stored on CDs and were commercially provided to them without having the chance to amend or add any data or information to such contents, or through getting lesson plans prepared by previous teachers in the school and they simply photocopied those plans.

Mathematics teachers chosen in the sample did not put comprehensive goals for higher order thinking skills, and they did not show their ability in lesson planning to present effective activities for their students in light of goals and learning content, during their lessons planning they did not observe the provision of enriching and remedial activities to deal with students' individual differences and mathematics teachers did not have interest in strengthening their relationship with students which contradicted with STEM and those results accorded with results of the study conducted by Cantrell, Pekcan, Itania and Velasquez (2006) which indicated teachers' low level in that regard.

Moreover, many mathematics teachers depended on tools and materials available inside the classroom and they did not attempt to bring new different materials leading to students' boredom and weak presentation of the learning content as well as many teachers did not read about new teaching strategies rather they depended on traditional means and materials. Mathematics teacher did not use any type of modern technological tools to attract students' attention such as the Internet, computer, data show and teaching aids. The researcher attributed that result to lack of necessary tools and materials for teachers, lack of most of teachers' interest in such tools which accorded with the goal of the lesson, most of them lacked sufficient knowledge and skills to use such technological tools and devices effectively due to weak connectivity with the Internet in schools, or school administration's and supervision's weak follow-up of the computerised content of curricula, lack of family's interest or ignorance in the computerised content. Thus, it is necessary to carry out research to address reasons which hinder the use of computerised curricula to benefit from this international tend in this regard. Those results also attributed to lack of employment of such technological media and tools as well as weak reinforcement of teachers morally and financially and lack of professional training workshops. Therefore, it is necessary to familiarise experts and developers of curricula in Jordan with recent international research and conferences in mathematics curricula domain (Becker & Park, 2011) which accorded with the result of the study conducted by Suwaid (2013) which indicated teacher's lack of interest in using modern teaching means and tools as well as their poor computer skills.

Additionally, those results also attributed to mathematics teachers' lack of interest in participating in training courses and programmes and lack of interest in the correct evaluation method and they were not interested in obtaining feedback since they claimed that they increased their work burden as known through the session held with them after attending their lessons and that result emphasised and accorded with the study conducted by Stinson, Harkness, Meyer and Stallworth (2009) which indicated mathematics teachers' weak practice of STEM.

As shown in the results, most individuals included in the sample had traditional perceptions that based on superficial viewpoint of mathematics teaching apart from science, engineering and technology attributed teachers' lack of training during their undergraduate study on using modern teaching strategies to provide supportive environment to students' learning based on STEM. During informal and personal discussions held with teachers after attending their classes, they stated that they did not have any idea about the way of integrating among STEM and some teachers did not have clear idea and perception about preparing class environment to make their students more active and effective learners and teacher only based on traditional teaching methods where students were passive learners who just listen to teacher's explanation without providing viewpoints their learning indicating mathematics teachers' weak awareness about linking their students' learning in general and mathematical learning particular with their lives because mathematics teachers' lack of understanding of the teaching–learning process goals and objectives, most importantly developing students' various and different skills which could be achieved through using STEM (Jensen & Sjaastad, 2013; Han, Capraro & Capraro, 2015).

This might be attributed to mathematics teachers' inconvenience and dissatisfaction about the importance of integration between engineering and mathematics in developing students' thinking skills, and most teachers thought that achieving such integration was difficult and inapplicable as well as all training courses and programmes offered to teachers did not address the importance of engineering and its integration with other domains in the teaching–learning process (Muhaisin & Khaja, 2015). It is clear that the role and vocational rationale and attitude towards STEM are still ambiguous to mathematics teachers as indicated in the studies conducted by Thomas and Williams (2010), Wang (2012) and Williams (2013) and based on the study carried out by Silk, Higashi, Shoop and Schunn (2010) it can be stated the current practices of mathematics teachers cannot lead to effective and creative class environments to develop students' personality to be active members in their community through developing their abilities, self-reliance and sense of responsibility.

3.2. Does the degree practices for mathematics teachers STEM differ according to their qualifications and years of experience?

3.2.1. Scientific qualification

Results derived from the observation card were classified into two groups according to teachers' scientific qualifications: teachers who hold bachelor degree and those who hold graduate studies certificates, then T-test was carried out to examine statistical significant differences among arithmetic means and the results came as shown in Table 3.

Table 3. Means, standard deviations and *T*-test results of scientific qualification

Scientific qualification	No.	*M*	SD	*T*-value	DF	Sig.
Bachelor	19	6.21	1.87	0.48	28	0.63
Graduate studies	11	5.82	2.56			

As shown in Table 3 there was not any statistical significant difference between arithmetic means of teachers who hold bachelor degree at 6.21 and their counterparts who hold graduate studies certificates at 5.82 according to the items included in the observation card and their T-value and statistical significance were $T = 0.48$ and $\alpha = 0.63$, respectively. That result showed that there were not any differences in teacher's practices (STEM education) between those who hold bachelor degree or their counterparts who graduate studies certificates. Those results might be attributed to lack of courses including mathematics which addressed STEM studied by teachers during their university study. Furthermore, graduate studies programmes did not focus on new mathematics teaching trends and strategies including STEM.

That result accorded the recommendation provided by the study conducted by Willson (2013) which recommended that higher education institutions should increase the number of training courses for university students in the field of science and mathematics and to pay more attention hold teacher's preparation programmes and courses on the way of employment of STEM in those universities. The results of the current study also accorded with the results of the study conducted by Cantrell and Taylor (2009).

3.2.2. Experience

Results derived from the observation card were classified into three groups: teachers with short experiences (5 years and less), teachers with medium experience (5–10 years) and teachers with long experience (10 years and more) and the results of that variable was shown in Table 4.

Table 4. Means, standard deviations of experience

Years of experience	No.	*M*	SD
5 years and less	10	6.00	1.76
5–10 years	13	6.00	2.12
10 years and more	7	6.29	2.81

It was shown from Table 4 that there were not any superficial difference among arithmetic means of teachers' scores and to examine whether there were any effects of years of experience in reaching those differences, one-way analysis of variance used and F-value significance value were $F = 0.046$ and sig. = 0.96 indicating that there were not any statistical significant difference at $\alpha = 0.96$ among the arithmetic means of mathematics teachers included in the study sample attributed to years of experience. Regardless of teachers' years of experience that result might be attributed to new advent of STEM in academic arena, lack of in-service training concerning the integration among the various fields of knowledge and those results came in line with the recommendation proposed by the study conducted by Muhaisin and Khaja (2015) which stressed the importance of teachers' experience in their professional development in light of STEM but the result of the current study did not accord with the results of the studies conducted by Ambo Sa'idi, Al-Harthy and Aashameh (2015) which did not show any statistical significant difference attributed to teachers' years of experience variable in practicing their teaching requirements as per STEM.

4. Conclusion

STEM has revolutionised perceptions and attitudes towards mathematics teaching and has considered it integral and indivisible, therefore the analysis of the study data results indicated that few teachers had correct and accurate perceptions about the employment of STEM to provide supportive class environment to develop students' skills. Moreover, teachers' lack of experience in practicing STEM had a considerable negative effect on student's academic performance and achievement.

5. Recommendations

- The importance of providing supportive class environment to students to be able to employ STEM which mainly depends on teachers' thoughtful planning of lessons so that the study suggests paying more attention to teachers' training on STEM skills to be able to furnish such supportive class environments that foster students' mathematical skills.
- The Ministry of Education should disseminate guiding brochures and manuals for teachers on how to deploy of STEM in the teaching process.
- It is necessary to carry out more research in the field of STEM and to examine the effect STEM-based training programmes and courses on enhancing student's mathematical skills and attitudes towards.
- Directing researchers' attention and interest to develop measurement tools, which characterised with high degree of reliability and validity in the field of using STEM in enriching student's learning skills.

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