ESTEEM Academic Journal
Vol. 17, March 2021, 67-76

Practicing BizMath Challenge Modul for Primary Schools based on the STREAM Curriculum

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ARTICLE HISTORY

Received
26 February 2021

Accepted
17 March 2021

Available online
31 March 2021

ABSTRACT

The learning process has evolved tremendously over time. Notably, in the 21st century, different types of technologies are used to make learning accessible anytime and anywhere to a generation of students who were brought up during the age of digital technology and are familiar with computers and the internet from an early age. Thus the Science, Technology, Engineering and Mathematics.(STEM) approach aims to help these students understand and learn in the best way. The objective of this paper is to build up students skill through their interest in Science, Technology, Reading, Art, Mathematic.(STREAM) module. This paper focusses on one such way that is mathematical learning outside the classroom. The 'BizMath Challenge' modul is an innovative project that is based on the curriculum of STREAM and fulfills the mathematics syllabus at the primary school level. The curriculum of STREAM is applied in this project to nurture the values of learning through the five scopes of education. In addition, the concepts of IQ (Intelligent Quotient), EQ (Emotional Quotient), problem solving and innovation design are also employed. To measure the variables of the study, a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) is used. R statistics programming is used to run the descriptive analysis and correlation analysis. The results show that the BizMath Challenge brings benefits students' learning by improving their mathematical skills and knowledge. Conventional methods are deemed less attractive to these students who prefer learning outside their classrooms as they can connect the lessons with their environment and everyday life. Therefore, educators need to do a great job in preparing the change based on learning activities and should start getting acquainted with STREAM projects.

Keywords: *Mathematics Outreach Program; Primary School Students; School Curriculum; STREAM Education; Teaching and Learning*

1. INTRODUCTION

With the arrival of the Industrial Revolution 4.0, the field of STEM becomes the fastest growing field of learning in the world. STEM was first introduced and implemented in Malaysia several years ago [1]. STEM is one of the most talked about topics in the education field. What exactly is STEM? The meaning behind STEM is Science, Technology, Engineering and Mathematics. STEM is a field of knowledge that integrates learning and practice. It is an application and integration of Engineering practices with Science and Mathematics subjects to foster collaboration and communication between students to design technologies that solve real-

p-ISSN 1675-7939; e-ISSN 2289-4934

world problems [2,3]. Various efforts have been implemented in producing competitive human capital and experts in the field of STEM [4]. Not only that, in attracting students to participate in the field of STEM, apart from the acquisition of the knowledge and scientific concepts, various activities have been implemented through game-based learning [5,6,7]. Eventually the dynamic field of STEM allows researchers and educators to transform it into STREAM (Science, Technology, Reading, Art, Mathematics) for the Malaysian education.

The transformation from STEM to STREAM learning in Mathematics and Science was introduced a while ago in Malaysia [8]. However, previously not many educators are able to implement this method in their learning and teaching sessions as well as in their activities outside of the classroom. This is because the method of inquiry discovery is quite difficult to implement and there were not many modules developed to help educators to apply this method in their teaching and learning. The difference between STEM with STREAM fields is the integration of art and reading so that through aesthetics and creativity, children's interest in STEM fields can be nurtured easily. So, to train future scientists and technologists who are innovative and successful, students need to be instilled with the love of reading and taught how to appreciate reading. Art and reading bring a multidisciplinary approach in STEM and are agents that promote cross-curricular teaching. The STREAM curriculum used in this innovation module was introduced to foster values in learning through the five areas of education [3,9]. STREAM based learning is important to ensure that students truly understand what they are learning, improve their attitude toward learning and enhance their ability to apply what they are learning in the real world. Inquiries start with questions or problems and are followed by observation, exploration, investigation or experimentation, conclusion and explanation (communication). The development of modules based on the STREAM curriculum enables students to use their curiosity to explore areas of knowledge learned especially in Science and Mathematics education. Next, sSection 2 is the literature review of the relevant topics regarding STEM, STEAM and STREAM modules. Section 3 discusses in detail about STREAM module that has been developed in this BizMath Challenge program. While section 4 is the research methodology, section 5 is the finding and discussion. Lastly, the conclusion based on the results obtained is in Section 6.

2. LITERATURE REVIEW

STEM education has been explored by so many researchers for quite sometime. This education involved all levels of education from primary to the university. Due to the need of the STEM education world wide, many actions have been taken to explore more about this type of education. There are many modules related to STEM that were designed and developed to improve students' attitude toward learning. For example, in 2019 a module was developed as an alternative to increase students' interest and understanding in solving a synopsis of learning in STEM. The module had been successfully created and proved that STEM can enhance students' knowledge, skills and attitudes towards science and mathematics [10]. Another module was created for 96 students from 22 primary schools in Mathematics subject to help students in reducing their Mathematics anxiety and increase their appreciation of Mathematics [11]. There was a STEM module that was created to identify students' interest based on a detective role-play setup and its impact on the peer-peer mentoring approach. The students used stations full of samples collected from the crime scenes such as fingerprinting, bool typing and others [12]. STEM Education encourages students to explore real life problems based on inquiry, project and problem [13].

p-ISSN 1675-7939; e-ISSN 2289-4934

STEM Education does not only apply to students, it is also widely use to produce quality workers who have broad competencies in both STEM and non-STEM areas. This criteria is a requirement to meet the future demands of STEM-driven economy [14].

In 2013, Terry Dubetz and Jo Ann Wilson, conducted a study on a program called GEMS (Girl Engineering Mathematics and Science) in which a group of middle school female students was exposed to additional learning experiences beyond the classroom. In this program, these students were provided with hands-on activities in which they were exposed to laboratory and field experiences. This outreach program provides students with the exposure of variety fields of Science, Engineering and Mathematics and also prepares them to the world of higher education. Throughout this program, students gained a lot of confidence by learning outside of their major fields study and increased their understanding of sciences. Thus, GEMS achieved positive outcomes to students' learning experiences. Another positive outcome was students were eager to attend university after finishing their high school. This is important to ensure even the most vulnerable students are well educated and knowledgeable [15].

For young children, a holistic education is crucial for the development of their well-being. Challenges for tomorrow are more complex and unpredictable. Thus, children need to be educated through the best education system that ensures they will have extensive interdisciplinary knowledge and skills to become successful in the future [16]. That is the aim of STEM, STEAM and STREAM education. They involve teaching and learning strategies that can enhance the application of knowledge, skills and values in a variety of fields. Among the three, STEM was the earliest strategy to be developed. From the earliest time, it was essential for all the educators to prepare and educate their students in this strategy due to the positive impact that it gave students. For quite a while, STEM was recognized as the leading strategy in our education system. But soon after that, the art field was added and STEAM was created. Incorporating art has allowed children to be more creative and increased their technical skills [2].

In 2015, Wok Seok Seo and Chang Hoon Leo did a case study of a STEAM outreach program development and its application. In this study, 184 middle and high school students were involved. Throughout this study, students' workbooks, teachers' guidebooks and the program operation manuals for staff in a university were developed by experts. The purpose of this study was not just to develop a module for STEAM education but also to analyse the users' satisfaction level with the contents and activities. At the end of the study, an activation plan was discussed from the findings for a sustainable development and operation of the STEAM outreach program [16].

Then from here STREAM was developed. Reading is added because it is recognized as a foundation to all the other subjects. Art and reading are also added to encourage students with analytical minds to be more creative and think out of the box. [8]. Due to the benefits of the STREAM education, numerous studies were done. One of them is Tamara *et al.* in 2019. The main purpose of the study was to establish a two-way communication between a computer game design process using a robotic system and Arduino microcontroller sensors. The computer game that was developed used a STREAM element to strengthen the motivational activity. In the process, five computer games were created using the Scratch software tool for managing graphic objects based on signals from the Arduino UNO microcontroller sensors [17].

p-ISSN 1675-7939; e-ISSN 2289-4934

Another study related to the system was also done in 2017. Acording to Lommatzsch *et al.*, the study looked at the effectiveness of instructors teaching the news recommender system to their students. Besides this, students would experience and understand the real life situation of data scientists [18].

In 2020, a research explored primary teachers' views towards STREAM in their teaching and learning. Even though their views on STREAM were positive, they needed to have access to the technology and prepare other supporting equipment in order to achieve best results in STREAM education [19]. Besides that, a study looked at reducing the work stress level among primary teachers. The value of STREAM in mapping an education approach can help to overcome the work-related stress of teachers in educational services. The results gathered from this study was practical but can be implemented on a short term only. Thus, more studies need to be done in this area [20].

3. THE STREAM MODULE

In an effort to enhance the interest of children in this area of STREAM, the authors have developed a STREAM Module, called the BizMath Challenge or Business Mathematics Challenge. The program was designed as a half day program at UiTM Johor branch, Pasir Gudang Campus and successfully conducted using the BizMath Challenge module developed by lecturers from the Faculty of Computer Science and Mathematics, UiTM Johor branch, Pasir Gudang Campus. It was facilitated by ten undergraduates from this university. The lesson is divided into four modules which were created by the concepts of Intelligent Quotient (IQ), Emotional Quotient (EQ), problem solving and innovation design. In the IQ session, students will be given questions of different difficulty levels to answer while in the EQ session, students will be given a task to evaluate their emotional quotient. In the next session, students will be given questions of problem solving-based and lastly, they must construct an innovative design based on what they have learnt from the problem solving session. All the four modules were conducted in Bahasa Melayu.

3.1 BizMath Challenge Program

All four modules were conducted in groups. Students will be in the same group from Module 1: IQ to Module 4: Innovation Design.

3.1.1 Modul 1: Intelligent Quotient (IQ)

The IQ module was taken from a topic in Chapter 5 of the primary 6 Mathematics Subject which is Money. The objective of this module is to expose primary school students to the concept of money. The questions will be given in three levels of difficulty which were easy, medium and difficult. In each level, students are provided with a certain amount of money. Students who answered the question correctly will get the money based on the questions that were successfully solved. The more difficult the question is, the more money they will be given.

3.1.2 Module 2: Emotional Quotient (EQ)

In this EQ module, students will be given the set of 3D puzzles. The objective of the module is to challenge students' intelligence, to examine the emotional quotient level, to increase the focus stage and to test the level of understanding in installation instructions. This module is

p-ISSN 1675-7939; e-ISSN 2289-4934

suitable for children who are six years old and above. Students need to assemble the 3D puzzle in the time given. The fastest group to complete the puzzle installation , will win the competition and will be given the highest value of money.

3.1.3 Module 3: Problem Solving

In this module, the money collected from Module 1 and Module 2 will be merged. The objective of this module is to increase the confidence level of students to spend their money effectively without being overpriced or short of money. They will be given instructions by the facilitators to discuss the items that they need to buy in 10 minutes. Next, a student representative will be given 5 minutes to buy the items in the store provided by the facilitator. Then, the facilitator will calculate the total price of the items that they bought. If the total price of the items were more or less than the amount of money earned, a penalty will be imposed on the group.

3.1.4 Module 4: Innovation Design

The objective of this module is to put into practice the ideas to create a dream garden. Students were given 30 minutes to complete the dream garden using the materials purchased in Module 3. After completing the task, the two judges will examine the finished products using a set of rubrics. The group that meets the criteria of a dream garden will be the winner.

4. RESEARCH METHODOLOGY

There are 40 primary students from Sek. Keb. Bandar Seri Alam (SKBSA) a school located in Johor, Malaysia who joined the Bizmath challenge and their background level of mathematics is mostly fair. In this study, a structured questionnaire was designed to achieve the objectives of our study. The reability and validity of questionnaire is tested by applying alpha cronbach test and the results show all the sections are more than 0.6 [21]. It implies that the questionnaire are acceptable and valid for further analysis. We then distributed the questionnaires to students before and after the program.The questionnaire has three sections; A, B, and C. Part A asked about the students' level of interest in fun learning. The authors wish to compare the use of a classic indoor inquiry method with active learning games outdoor learning method based inquiry mixed problems through the Bizmath challenge program. Part B describes the role of facilitators in the success of the program and Part C, is to get the feedback about the whole program regarding improving students' mathematics knowledge and skills as well as attracting the students to the subject.

Part A in our analysis was excluded due to incomplete and missing data. Therefore, only part B and part C were analyzed as all students answered the questionnaire after the program. To measure the variables, the instrument used was a structured questionnaire with a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The description of the questionnaire items is in Table 1.

5. FINDING AND DISCUSSION

R statistics programming was used to run the descriptive analysis and correlation analysis. The questionnaire in section B and C were also analyzed. The descriptive summary of both sections is presented in detail in Table 2.

p-ISSN 1675-7939; e-ISSN 2289-4934

Table 1: Summary description section B and C questionnaire in the Bizmath Challenge

Section	Variables	Description
B	F1	The Facilitators were very cooperative and help students throughout the program.
	F2	The facilitators have the knowledge and skills in the program.
	F3	The facilitator encourages and motivates students to study mathematics
C	P1	This program promotes teamwork among students
	P2	This program helps students learn the various mathematical solution methods
	P3	This program builds self-confidence in mathematics solutions
	P4	This program increases the morale of doing mathematics exercises
	P5	This program can improve the interest and motivation of students to study mathematics
	P6	The time allotted to students is sufficient
	P7	The program objectives are organized and tailored to the students
	P8	The program should continue in the future
	P9	The whole program helps improve skills, mathematical knowledge and benefits students

Table 2: Descriptive summary variables section B and C in the Bizmath Challenge

Variables	Mean	SD	Median	Min	Max	Valid number
F1	4.6	0.55	5	3	5	40
F2	4.55	0.6	5	3	5	40
F3	4.62	0.7	5	2	5	40
P1	4.65	0.58	5	3	5	40
P2	4.55	0.64	5	2	5	40
P3	4.55	0.68	5	2	5	40
P4	4.58	0.64	5	3	5	40
P5	4.62	0.63	5	3	5	40
P6	4.55	0.71	5	2	5	40
P7	4.65	0.53	5	3	5	40
P8	4.62	0.59	5	3	5	40
P9	4.65	0.53	5	3	5	40

From Table 2 we can observe that the mean for all variables is from range of 4.55 to 4.65. The value shows quite a high mean since the maximum value of the Likert scale is 5. Furthermore, the median of the variables also shows all are the same at the maximum value, 5. The lowest mean in section B is F2, the facilitators have the knowledge and skills in the program. In this program, lecturers have appointed diploma students in semester 1 to be facilitators for the program. There were times when a few particpipants might not feel comfortable and the facilitators could not understand the way to handle the participants' problems. This lack of knowledge and skills in the program could be the reason for the low score as several facilitators were involved in the program for first time. Even though the score for the variable was more than 3 (fair), the authors still took note of this in order to improve the way future programs will be conducted.

p-ISSN 1675-7939; e-ISSN 2289-4934

In section C, we have the feedback of the whole program, whether it improved students' knowledge, skills and attracted the students to Mathematics. The result shows the highest value is 4.65 for three variables P1, P7 and P9 whereas the lowest value is 4.55 for three variables P2, P3 and P6. We also can observe several ouliers incur in variables P2, P3 and P6 in Figure 1. P6 had more outliers since the standard deviation is too far from the central mean,that is 0.7. It is followed by P3 and P2 with their standard deviation 0.68 and 0.64 respectively. Therefore, the variables P7, P2 and P3 need to be improved to tailor to the participants from primary shcools. Besides that, the facilitators need to be trained better to help participants build up their confidence level and learn various of methods to solve mathematical problems.

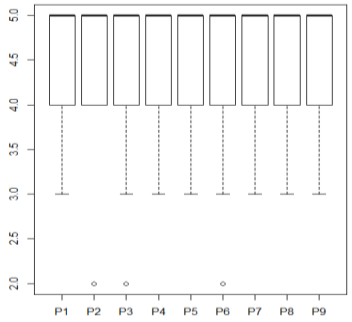

Figure 1: Boxplot variables in section C

From the overall result, we can view that the whole program helps improve skills, mathematical knowledge, and benefits students (P9) with the highest mean value score of 4.65. Furthermore, students support the program with question P8 to continue this program in the future (4.62).

Table 3 is the summary of the correlation matrix between the variables in section C. The bold color shows the highest and lowest correlation values. Through the correlation analysis, the result shows that variables P3 and P4 have the highest correlation of 0.855 at a significant level of 0.001. It indicates there is a strong positive association between the morale of doing mathematical exercises and building self-confidence in Mathematics solutions. The more students do the exercises, the more self-confidence will be developed. Therefore it can make a positive impact to improve students' performance and ability to solve problems in Mathematics.

Table 3: The correlation and significance level for variables in section C

	P1	P2	P3	P4	P5	P6	P7	P8	P9
P1	*****	0.608	0.654	0.807	0.645	0.643	0.33	0.344	0.623
P2	<0.001	*****	0.659	0.706	0.61	0.335	0.259	**0.212**	0.451
P3	<0.001	<0.001	*****	**0.855**	0.763	0.51	0.512	0.569	0.802
P4	<0.001	<0.001	<0.001	*****	0.768	0.557	0.466	0.388	0.746
P5	<0.001	<0.001	<0.001	<0.001	*****	0.655	0.343	0.399	0.629
P6	<0.001	0.035	0.001	<0.001	<0.001	*****	0.614	0.651	0.635
P7	0.037	0.107	0.001	0.002	0.03	<0.001	*****	0.683	0.524
P8	0.03	0.189	<0.001	0.013	0.011	<0.001	<0.001	*****	0.671
P9	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	*****

p-ISSN 1675-7939; e-ISSN 2289-4934

While P2 and P8 show the lowest correlation at 0.212, but the value is not significant. Therefore, we can conclude, P2 and P8 is not correlated to each other. For variable P9 all the variables are correlated with significant value at below 0.005 or <0.005. The highest is at 0.802 (P3), and the lowest is at 0.451(P2). Therefore, the variables can assist the measurement of the program to improve students in their learning or outreach program learning in Mathematics or other subjects. The findings show that students are likely to support elements in the STREAM outreach programmes and build up their skills through the interest in doing exercises (variable P4). Thus, Bizmath challenge will increase students' knowledge and give benefit to them. Please ensure uniformity for Mathematics – to be capitalised but mathematical – no need for capital letter.

6. CONCLUSION

The BizMath Challenge module has been developed based on the STREAM element and its activities are generally based on inquiry learning. The study has shown that this programme can enhance students' knowledge, skills and attitudes towards mathematical subjects. Not only that, the activities conducted can help shape students to be critical, creative, imaginative and are able to use their curiosity to explore new fields of knowledge. The students involved in this study are excited to learn about STREAM and enjoy STREAM knowledge from the modules provided in the context of the actual application-based inquiry. It can be concluded that the BizMath Challenge Programme can make a positive impact to improve students' performance and ability to solve real life problems that involve mathematics.

Therefore, in order to realize the first shift in the Education Development Plan 2013 - 2025, which is to strengthen STEM education for school students, as educators we must transform first from within ourselves. We are faced with the present generation who needs to be prepared with the right thoughts, experiences and knowledge about STEM and STREAM to enable them to pursue their increasingly challenging future. As such, educators as change agents do a great job of preparing students for change. Educators should start getting acquainted with STREAM projects and inquiry-based learning activities. In addition, educators also need to review STEM reading materials to build or enhance accurate knowledge and understanding of STEM. The production of modules also needs to follow all the elements in STREAM itself so that the purpose and intent of writing can be conveyed to the reader. Clearly, the study conducted under the BizMath Challenge will serve as an alternative source of reference and education in schools to support national education policy in strengthening the development of educational development plans for 21st Century Learning excellence.

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