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CIPP Model to Evaluate Physics STEM-Based Learning Activities (STEM-bLA)

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Abstract. The purpose of this study is to evaluate a series of STEM-based learning activities, STEM-bLA, in gaining students' interests towards the topic of Force and Motion. In developing the STEM-bLA the researcher explores the characteristics of learning activities that can attract students' interest, especially among form four secondary physics students in an ordinary daily school in a rural area of Sabah. Then based on identified learning activities, the researcher planned a series of STEM-bLA, which aim to project changes in students' conceptual understanding of the topic of Force and Motion. This evaluating research adopts a case study approach to explore the real context bounded such as informants, place, and time. This qualitative study took place at one of the science stream classes consist of 17 students in an ordinary B school in a rural area of Sabah. Data were collected through observation, conversation in the classroom, student's responses in the activities task given, diagnostic test, pre and post-test used the STEM-based learning activities. The result shows that this STEM-bLA gain students' interests in learning Physics. Besides that, there were changes in student's physics conceptual understanding. The prior misconception manages to be fixed. At the same time, a new misconception is being discovered. As an educational practitioner, this STEM-bLA is found as teaching aids, especially for selected physics concepts. Besides that, this STEM-bLA act as an 'engagement tool' to catch students' interest to learn. Finally, this STEM-bLA can be used as a 'learning probe' to monitor the development in conceptual understanding among the physics students for selected physics concepts. However, there were only a few physics concepts and topics of Force and Motion involved in this study. As a result, the qualitative findings later were used to develop a framework that helps teachers implement STEM-bLA in teaching and learning physics concepts for the topic of Forces and Motion. The framework can be used effectively to allow meaningful science learning, develop conceptual understanding, and nurture students' HOTS. Due to that reason, as suggested for further study, more STEM-bLA will be designed. The activities will cover other topics and more physics concepts. Soon this effort can produce more attractive physics learning activities among the students and helps in developing student's physics conceptual understanding.

Keywords: CIPP, STEM, Learning, Activities, Physics

INTRODUCTION

The purpose of this study is to describe and evaluate a learning program. The evaluation focuses on the developing and implementation of STEM-based learning activities, STEM-bLA in learning the concept of Force and Motion among Form Four secondary school physics students. The evaluation study focuses on the context, input, process, and product dimension in an evaluation model by Stufflebeam, 1971, from the view of an educational instructor, the teacher. This study was carried out in 2017, the second year after the enhancement of the STEM initiative was introduced nationally.
Research data was collected from multiple classroom observations and interviews with the school principal, physics teachers, and physics students. The study was set up in a rural school to observe the actions in their context of occurrence.

PROBLEM STATEMENT

In 1967, HEPC reported that 4 per cent of the students in secondary school would continue their education at the tertiary level. This action was taken to ensure that our nation would have sufficient human resources in the science and technology sector. There will be 60 per cent of the students in school must be allocated in the science stream. Since then, the 60:40 policy has been implemented in our educational system. The National Educational Policy: Item 4.9 had stated that every secondary school must achieve that ratio (MEDP, 2001-2010 in MOE, 2001).

According to Nor Azlina (2015), Malaysia has put education as the utmost priority in driving the effort to achieve vision 2020. However, up till this day, this 60:40 ratio policy has yet to achieve its target. Few identified factors on why lesser students choose the science stream, compared to the art stream in the upper secondary level. According to the Achieve Strategy 60:40 Science/Art Stream policy report (2013), some students lacked the science stream at the universities. There were four main aspects identified that have contributed to the shortage in the number of students involved in both science and technical fields. The four main aspects were curriculum, self-awareness towards science and technology, carrier path, and teaching and learning quality (Achieve Strategy 60:40 Science/Art Stream policy, 2013).

PURPOSE OF THE STUDY

Evaluating an educational program is "an inquiry that sets out to explore some educational program to focus on its worthiness" (Bassey, 1999). There are many reasons to evaluate an educational program, including determining achieved learning objectives, justifying the learning activities, and better learning outcomes (Horton, 2001). Horton (2001) believe that the best evaluation studies are comprehensive. Here the evaluation data provide insights into (1) the process of implementation; (2) all effects, intended and unintended, positive, and negative; and (3) underlying values. With this information, the evaluator can then

identify specific areas to improve the weakness of existing teaching and learning materials and add more and better teaching approaches. In this respect, the evaluation process may be "more important than the data it gathers if it strengthens efforts to apply knowledge" (Horton, 2001).

This study focused on evaluating a learning program through STEM-bLA for the topic of Force and Motion and its implementation among Form Four secondary school physics students planned and designed by the researcher. At the same time, these STEM-bLA act as teaching and learning aid.

Then after the evaluation, it is hoped that the findings will assist teachers in improving students' learning and improving their teaching approaches. At the same time, the researcher's expected that the learning activities used can promote students' cognitive, emotional, and social development.

RESEARCH QUESTIONS

There are three primary research questions which are:

I. What learning activities are used in the physics classroom?
II. What is happening in a physics classroom in a rural school context?
III. What factors affect students' learning of physics subjects in school?

Some secondary questions, as shown in Table 1, cooperate with the research aims.

Table 1: Research Aims and Research Questions

Evaluation	Research	Details
Context	Aim 1	To develop a series of STEM-LA for the topic of Force and motion using constructive learning theory.
	Question 1	What are the contents that are suitable for STEM-based teaching and learning activities for the topic of Force and Motion using constructive learning theory?
Input	Aim 2	To explore the needs to use STEM-bLA in a rural school.
	Question 2	What are the needs (both students and teachers) to use the STEM-bLA in a rural school?
Process	Aim 3	To explore the impact of using STEM-bLA in students' conceptual understanding of the topic of Force and Motion.
	Question 3	How does STEM-bLA influence students' conceptual understanding of the topic of Force and Motion?

	Aim 4	To explore the impact of using STEM-bLA in students' interest in the topic of Force and Motion.
	Question 4	How does the STEM-bLA influence students' interest of the topic of Force and Motion?
Product	Aim 5	To develop a framework of STEM-bLA for teaching and learning topic of Force and Motion for Malaysian Rural Schools.
	Question 5	What is the framework of STEM-based teaching and learning activities for Topic of Force and Motion using constructive learning theory in Malaysian Rural Schools?

LITERATURE REVIEW

Enhancement of STEM Initiative. The integrated learning in Science, Technology, Engineering, and Mathematics implemented with real-life context defines STEM education. To produce a skilled and STEM literate community that drives national economic development, this education itself connects the educational institution with the industry (MOE, 2015).

The STEM education concept is also defined as a long-lasting education that includes integrated learning of Science, Technology, Engineering, and Mathematics through formal based on curriculum, informal through co-curricular and co-academic activities, and not formal through indirect learning. Parallel with the concept of a long-lasting education, it will cover all stages of ages start with pre-school, primary school, lower secondary school, upper secondary school, and tertiary level until industry/community level (MOE, 2016).

This education aims to produce STEM literate students who have these three skills; identified, applied, and integrated. To solve the given task, students will use both hand-on and open-exploration approaches. Later with these skills, students can understand the given problem and solve it creatively and innovatively. Moreover, the issues presented will apply to the real-life context. Figure 1 shows a summary of the concepts of STEM education.

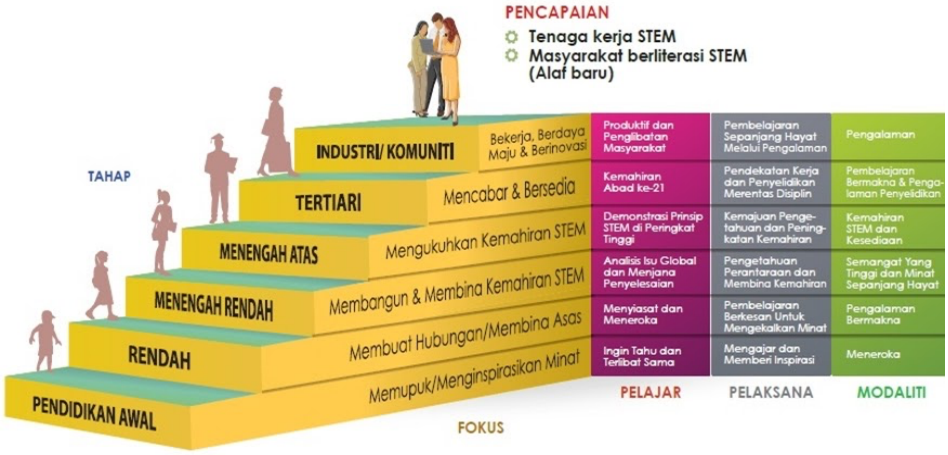

Figure 1: Concepts of STEM Education

Source: Kementerian Pendidikan Malaysia, KPM. 2016. Panduan Pelaksanaan Sains, Teknologi, Kejuruteraan, dan Matematik (STEM) dalam Pengajaran dan Pembelajaran

Malaysian Educational Development Plan, MEDP 2013-2025 had placed STEM education as the leading national plan to transform national education. STEM here acts as a 'provider' to make the young generation ready to face the upcoming challenges in the 21st century. STEM education will be implemented through MEDP 2013-2025 in three waves, as shown in Table 2.

Table 2: STEM Initiative Implementation Waves

Implementation Wave	Period	Activities Planned
First wave	2013-2015	Enhancement of STEM education quality through curriculum reinforcement, testing and training among teachers, implementation of multiple mode of learning models.
Second wave	2016-2020	Campaign and support from external and internal educational body; to gain STEM interest and awareness among the school community.
Third wave	2021-2025	Expand the operation area; STEM education moves toward excellent.

In teaching and learning, STEM education focuses on creating a learning environment that is convenient to produce meaningful and interesting learning experiences for the students. Mohd Noor (2018) said that interesting teaching and learning could gain students' interest and tendency toward STEM subjects.

In this study, interesting teaching and learning mean implementing STEM in teaching and learning concepts of Force and Motion among the form four secondary physics students.

Transformasi Nasional 2050 or TN50 is one of the Malaysian development initiatives that will be implemented from 2020 to 2050. According to Mohd Yusof (2017), TN50 continues the previous National development movement stated with Vision 2020, V2020 by Tun Dr. Mahathir Mohamad in 1990, followed by Islam Hadhari by Tun Abdullah Ahmad Badawi in the year 2006. Then 1 Malaysia was proposed by Dato' Seri Mohd Najib Tun Abdul Razak in the year 2017. The clear mission has driven the TN50 initiative, and the target has operated for 30 years. TN50 has been developed through the negotiation process and has undergone the preparing phase from the year 2017 to the year 2019. One of the main challenges listed in TN50 is developing sustainable science, technology, environment, and health. Science and technology are seen as a method to understand and learn from nature, but both science and technology have a view from scientific thinking (Mohd Yusof, 2017).

In the same year, 2017 Malaysian government has introduced a STEM integrated action plan (National STEM Movement) to boost Science and Mathematics education at the school level. According to the acting vice higher educational minister, Datuk Dr Mary Yap Kain Ching, the National STEM Movement will collaborate with few parties. The parties are the government, Higher education Minister, university, teachers, and non-government organisations, NGOs to share their expertise to support the effort to prepare skilled human resources (Syarime Wosley, 2017). According to Dato' Dr Noraini Idris (2016), parallel to form the National STEM Movement, this movement is defined as a group of people working together to advance their shared political, social or artistic ideas. Second, the formation of the National STEM Movement through a group of individuals, agencies and institutions working together to advance their shared passion for STEM programs for the country. Third, the synergy gathered through the movement will gear Malaysia forward through STEM education.

The objective of the National STEM Movement is to drive passion in fundamental subjects in STEM. The following purpose is to nurture excellent scientists for the country. Then, to instil students and parents about the importance of science subjects. Finally, to develop a career path for scientists (Noraini Idris, 2016).

Learning.

Learning involves acquiring and modifying knowledge, skills, strategies, beliefs, attitudes, and behaviours (Dale, 2012).

21st CL. 21st Century of learning *or Pembelajaran Alaf Ke-21, (PAK2*1) has been defined as an effort to produce global, a national citizen who has the skill, knowledge and motivated to overcome humanitarian issues and sustainable environment, able to respect and open towards dialogue (DiBenedetto & Myers, 2016).

Contructivisme Learning.

Constructivists assume that previous knowledge has constructed new knowledge. Irrespective of how the knowledge has been taught or while listening, all these activities involve active attempts to create new knowledge (Cobb, 1994).

Constructivism can be seen through the learning process, where teachers should never tell students anything directly but, instead, should always allow them to construct knowledge for themselves. Some writings like Fish Is Fish by Lionni (1970) show that attempts to teach children that the earth is round by Vosniadou, and Brewer (1989) show why simply providing frequent lectures do not work.

Constructivism is a learning process that explains how knowledge is organised in the human mind (Norazilawati Abdullah, Abdul Talib Hashim, Rosnidar Mansor, Noraini Mohamad Noh, Norul Haida Redzuan, 2013). Constructivism believes that learning starts from experience, and then the experience is kept in memory storage or the student's cognitive structure. In the learning process, new knowledge is processed then absorbed to be part of the human cognitive structure.

Learning Activities.

European Union (2016) has classified activities in a classroom into two categories which were learning activities and non-learning activities. A Learning activity has defined as 'any activities of individuals organised to improve one's knowledge, skills and competencies.

However, among American researchers, the ideal STEM definition refers to Integrated STEM. The word "integrated" means all the four big ideas Science, Technology, Engineering and Mathematics being blended into one teaching and learning, teaching, and learning content (Bryan, Moore, Johnson, & Roehrig, 2016). Also, both content and practice in teaching and learning put together the ideas of Science and Mathematics elements with the concepts of Engineering and Technology (through the Engineering Design, ED) practice. Based on these definitions, the objective of Integrated STEM is to blend Science, Technology, Engineering and Mathematics in the teaching and learning process (Bunyamin, 2015).

A teaching module means a module that is specifically designed for a physics teacher to teach physics more effectively. The teaching module was a set of teaching aids complete with subject covers for specific topics. The teaching module also consists of strategies, actions, and exercises organised by teachers and the assessment of the subject content (Norijah, 1997). Abdul Rahim (1996) said that a module is a teaching text. These teaching texts can be explained, became references, or facilitated by the readers. The module is also a part of teaching design which is systematic and holistic to plan, expand, apply, and assess the learning and tools used.

According to Abdul Rahim (1996), teaching and learning modules affect students' interest and help students gain the information effectively. A study from Norijah (1997), showed that cooperative learning with a teaching and learning module had increased students' performance compared with the traditional teaching and learning method.

In this study, the STEM-bLA are designed based on the Five phase teaching and learning model by Needham and Hill (1987). These activities have been improvised in the Children's Learning Science, CLIS project by Science and Mathematics Educational Learning Centre of Leeds University (Ong & Yearn, 2003). The main characteristic of the learning activity is involved with the true context of a problem-solving environment. The true context means the content was related to a real-life situation (Cunningham, Daffy, & Knuth, 2000).

METHODOLOGY

Here, the researcher is adopting the CIPP evaluation model by Stufflebeam (1971) as her research design approach to examine the implementation of STEM-based learning activities, STEM-bLA in learning physics concepts for the topic of Force and Motion. Patton (1990), cited in Tay (2007), said that an evaluation research approach needs systematically and empirically through careful data collection methods and thoughtful analysis.

Later, the findings would provide useful feedback about implementing STEM-bLA (Patton, 1997; Trochim, 2006). A qualitative research design allows the researcher to explore learning physics concepts in a rural school in Sabah. The study explained knowledge and understanding of the problems concerning designing and implementing the STEM-bLA planned by the researcher in teaching physics concepts in rural form four secondary physics students. It is hoped that the findings would enable the researcher to make significant contributions in proposing a framework of STEM-bLA in a rural school context. Besides that, it is hoped that the designed activities help gain students' interest in learning physics.

The evaluation research is conducted using a qualitative approach that focuses on the phenomenological view where the subject communicated socially in the real world. The qualitative evaluation allows a researcher to understand profoundly and, at the same time, experience the phenomena in its context.

A case study is used to gain an in-depth understanding, focusing on the process to find out what goes on within the complex bounded system (Burns, 2000; Merriam, 1998). Simultaneously, a case study is to obtain a real situation through a group of people or even individuals. The following discussion elaborates more on the researcher's rationale for using a qualitative evaluation case study to evaluate the implementation of STEM-bLA in force and motion learning concepts among form four physics students in a rural school.

In this study, the researcher adopted Stufflebeam's evaluation model to evaluate the implementation of STEM-based learning activities, STEM-bLA, in learning the concept of Force and Motion. By referring to the research questions, there are four evaluation domains involved. The first domain is Context evaluation. Here, the researcher tries to develop a series of teaching and learning activities for Force and Motion. Again, the researcher attempts to identify all possible activities related to the syllabus's needs stated in the standard document of form four secondary physics school and associated with constructive learning theory. The researcher tries to identify the teachers' and students' readiness to use STEM subjects at this stage. Finally, the researcher attempts to formulate and determine the objective of the suggested activities. Students will be given

diagnostic tests to identify their prior level of physics concept understanding at this phase. The researcher will interview physics teachers, Science teachers, and the school principal to gain information. The info was around the physics students' demographic in general, other school support programs that exist to promote the STEM program, and the school's STEM program traits from the school administrator's perspective and physics teacher. The researcher will review a few documents, such as a standard document of form four secondary physics schools, physics textbooks, and other related physics learning activities, to ensure that the containment of the designed STEM-bLA is parallel with the national curricular.

Next, in the second evaluation domain, Input evaluation, the researcher tries to determine the learning domains that characterise the learning activities according to each Science, Technology, Engineering, and Mathematics component. Simultaneously, the researcher attempts to identify both teaching and learning strategies and resources in implementing the STEM-bLA. Finally, at this stage researcher try to establish the validity and reliability of the designed STEM-bLA. Here, the researcher will gain the related information from reviewing previous related literature and document analysis such as a standard document of form four secondary physics schools, form four secondary physics textbooks, and other related physics learning activities. Asking for expert's reviews for the designed STEM-bLA and carry out the pilot study. The activities will be tested and analysed during the pilot study. After that, the data is used to modify the designed STEM-bLA before being used in the actual study.

The next evaluation domain is Process evaluation. Here, the researcher starts to implement the designed STEM-bLA. At this stage, the researcher tries to describe the students' progress during implementing the STEM-bLA. Here, researcher will compare the actual and intended implemented process. At the same time researcher try to identify the strength and the weakness of the implementation process. So, at this stage, researcher will implement the STEM-bLA in the real physics lesson. In other words, carry out the actual study, observe the progress of students learning, interview the students, and review documents such as students' works.

At the final evaluation, the domain is Product evaluation. Here, the researcher will compare the intended outcomes with the actual outcomes. At the same time, the researcher tries to identify the unintended results of the implementation of STEM-bLA. Again, here researcher will carry out observations, interviews, and documents review. So, as a researcher and evaluator of a designed educational program, the prominent role here is to provide any feedback that might improve general education.

PARTICIPANT AND SITE. Creswell (2014) recommended that to present an in-depth understanding of the case, study a few instances only. Too many cases or spent less time investigating one particular issue will soon take longer to collect and then analyse the data. Tuckett (2004) said that samples in qualitative research were purposefully sampling because sampling relies on small numbers to study the people concerned in-depth and detail to obtain rich data about a phenomenon. One class of form four secondary physics students, F4SPS, is the sample for this study. Table 3 shows the number of participants involved in the

pilot study, while Table 4 shows the number of participants involved in the actual study.

Table 3: Number or Participants in the Pilot Study

Participants	Data collection method	Number of participants
School principal	Interview	1
Science and Mathematics Head of Department	Interview	1
Science teacher	Interview	1
Physics teacher	Interview	1
Students	Diagnostic test	21
	Pre-test	21
	STEM-bLA (11 concepts)	21
	Post-test	21

Table 4: Number or Participants in the Actual Study

Participants	Data collection method	Number of participants
School principal	Interview	1
Science and Mathematics Head of Department	Interview	1
Science teacher	Interview	2
Physics teacher	Interview	1
Students	Diagnostic test	20
	Pre-test	20
	STEM-bLA (5 concepts)	17
		17
	Post-test	17

According to Denzin and Lincoln (1994), qualitative research is a multi-method focus, interpretive and naturalistic approach towards the subject matter.

Worthen and Sanders (1987), cited in Tay (2007), suggested that an evaluation plan wherein for each evaluation research question, the items that need to consider are:

I. Information required to determine whether the objectives were achieved.
II. Information sources.
III. Methods of collecting information.
IV.

The researcher summarised the evaluation plan for this study by referring to this plan, as shown in Table 5.

Table 5: Evaluation Plan

Research Questions	Evaluation Objectives	Methods in collecting information
What are the contents suitable for STEM-bLA for the topic of Force and Motion using constructive learning theory?	To develop a series of STEM-bLA for the topic of Force and motion using constructive learning theory.	Curriculum Specification Textbook Experts' evaluation
What are the needs (both students and teachers) to use the STEM-bLA in a rural school?	To explore the needs (among both students and teachers) to use the STEM-bLA.	Diagnostic test Interviews with the teachers
How does STEM-bLA influence students' conceptual understanding of the topic of Force and Motion?	To explore the impact of using STEM-bLA in students' conceptual understanding of the topic of Force and Motion.	Student's written responses Teacher-students conversation in the class Teacher's journal
How does the STEM-bLA influence students' interest in the topic of Force and Motion?	To explore the impact on using STEM-bLA in students' interest in the topic of Force and Motion.	Student's written responses Teacher-students conversation in the class Teacher's journal
What is the framework of STEM-bLA for the topic of Force and Motion using constructive learning theory in Malaysian rural Schools?	To develop a framework of STEM-bLA for teaching and learning topic of Force and Motion using constructive learning theory for Malaysian Schools.	Analysed from the study

Qualitative research is the development of concepts that help us understand social phenomena in natural settings, giving due emphasis to the participants' meanings, experiences, and views (Pope & Mays, 1995 cited by Sunday, 2005).

There are five types of qualitative analysis: content analysis, narrative analysis, discourse analysis, framework analysis, and grounded theory (Creswell, 2014).

According to Saldaña (2015: 3), coding in its most basic form is the simple operation of identifying segments of meaning in your data and labelling them with a code, which can be defined as "a word or short phrase that symbolically

assigns a summative, salient, essence-capturing, and evocative attribute for a portion of language-based or visual data". Codes are created to understand the phenomenon or participants and their perspectives. As such, the researcher interacts with the phenomenon and the participants repeatedly through the empirical material. As a result, through the dynamic development of codes, we understand participants' views and actions from their perspectives (Charmaz, 2014).

RESULT AND CONCLUSION

In this study, the researcher has developed learning activities based on Science, Technology, Engineering, and Mathematics components. According to Robinson (1972), a learning module has many purposes such as (a) self-learning aids, (b) group learning aids, (c) minimize conventional conceptual model through verbal, (d) learning analysis (e) teaching and learning improvement tools (f) to increase effectiveness using media in learning and group activity, and (g) to encourage students to self-learning. This chapter's focus is to discuss the development of the series of STEM-bLA, starting from choosing an instructional design model, elaborating the development phase, expanding to the implementation phase, and closed with the explanation on the evaluation phase. Table 6 shows the summary of five phase in developing STEM-bLA.

Table 6: Summary Process of Development STEM-bLA

Phase 1: Analysis		
Process	**Method**	**Data**
Analysis teaching problems Analysis purpose and objective Site analysis Resources analysis Sample analysis	Comparing physics syllabus for both KBSM and KSSM Interviews both teachers (science, physics) and students Determine the purpose and objective of STEM-bLA Reviews the students' performance in PT3 for both science and mathematic Identify panel experts Identify the physics concepts covered in the STEM-bLA	Students found that physics as tough and formulated subject Teachers need more hands-on activities Time management in planning an activities Students positive towards STEM subject Identified school Identified panel experts

Phase 2: Design		
Process	**Method**	**Data**
Main objective Theories and models involved	Find related T&L theories and models Identify strategy to	define learning objectives of the activities list the involve theories and

	implement develop activities	models

Phase 3: Development		
Process	**Method**	**Data**
STEM-bLA Measuring tool Lesson plan	Develop the STEM-bLA 7 lesson plans 1 set diagnostic test 1 set pre and post test	STEM-bLA 7 activities 1 set diagnostic test 1 set pre and post test
Phase 4: Implementation		
Process	**Method**	**Data**
Implement the first drafts of STEM-bLA	Run pilot study	Preliminary data Adjustment
Phase 5: Evaluation		
Process	**Method**	**Data**
Analyse the data collected	Students' responses (writing) and interviews Panels' expert responses	**Formative evaluation (along the process)** Students' responses Panels' expert responses **Summative evaluation (at the end of each activity)** Trustworthiness of the STEM-bLATr ustworthiness of the diagnostic, pre, and post test

The discussion starts with elaborating the process of developing the STEM-bLA. Starting from choosing the ADDIE model as an instructional design model and then elaborating Needham Five Phase Model in developing STEM-bLA. This qualitative case study research portrays a deep understanding of implemented STEM-bLA in physics classrooms in a rural secondary school. The data collection took about three months. During the pilot study, the selected school will be acknowledged as School A to keep the respondent's privacy and trust. During the actual study, the school selected School B. Same goes for the corresponding teacher and students. There were two ordinary secondary schools involved, two physics classes, with 19 and 17 students respectively. The data comes from 20 sessions, ten sessions each during the pilot and actual study, two meetings with two school principals, and two meetings with science and physics

teachers. Figure 2 shows the focused points observed during the implemented STEM-bLA in the physics classroom.

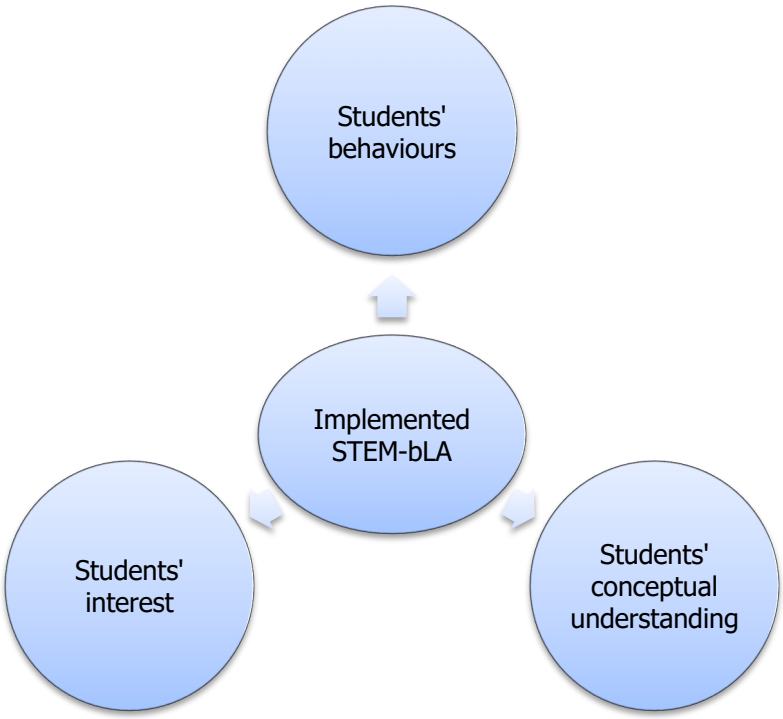

Figure 2: Focused Points Observed in Physics Lesson

The evaluation process is in a cycle means the evaluation flows are a continuous process. Figure 3 shows the summary of the framework used in this study.

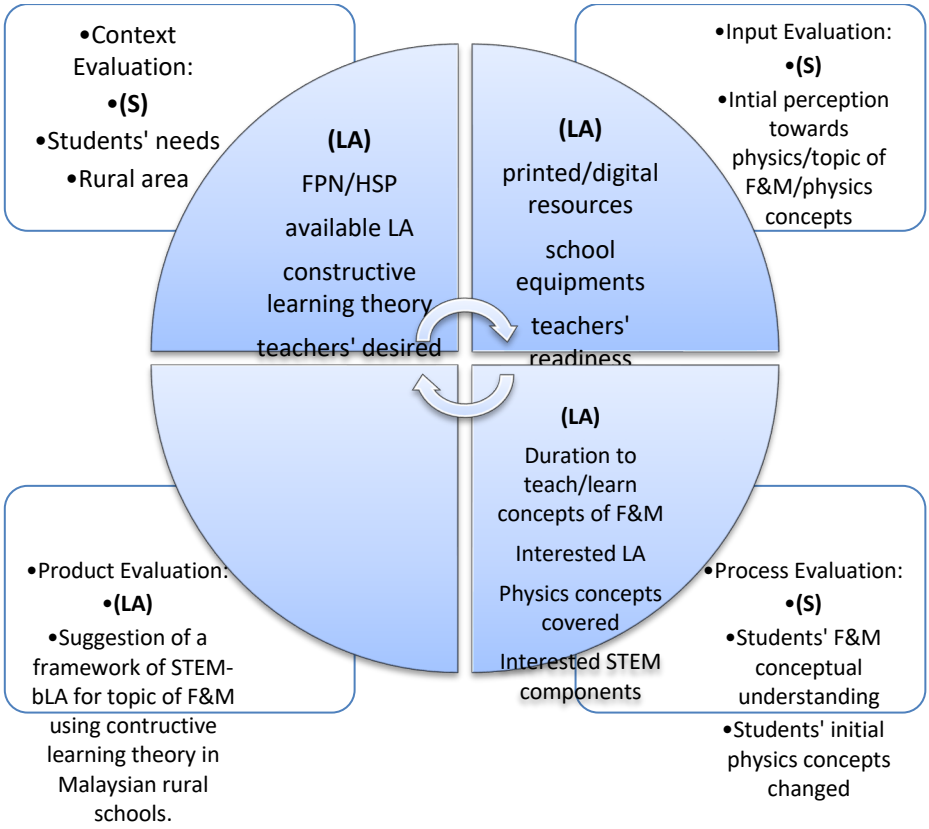

Figure 3: Suggested Framework of STEM-bLA for Topic of Force and Motion using Constructive Learning Theory in Malaysian Rural Schools

REFERENCES

Abdul Rahim Mohd Saad. (1996). *Mereka Bentuk Teks Pengajaran Secara Efisien dan Efektif*. Shah Alam: Penerbit Fajar Bakti.

Bassey, M. (1999). *Case Study Research in Educational Setting*. Buckingham, Philadelphia. Open University Press.

Bryan, L. A., Moore, T. T. Johnson, C., C, & Roehrig, G. H. (2015). Integrated STEM. In Johnson, C. C. Johnson, Peters-Burton, E. E., Moore, T. J. (ed.). *STEM Road Map: A Framework for Integration*. London. UK: Taylor and Francis. 23-37.

Bunyamin, M. A. H. (2015). Pendidikan STEM Bersepadu: Perspektif Global, Perkembangan Semasa di Malaysia, dan Langkah Ke Hadapan. *Buletin Persatuan Pendidikan Sains dan Matematik Johor. 25*(1). 1-6.

Burns, R. B. (2000). *Introduction to Research Methods*. 4th Edition. Thousand Oaks. CA: Sage.

Charmaz, K. (2014). *Constructing Grounded Theory*. (2nd Edition). London: Sage. London. 1-340

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 4th Edition. Thousand Oaks, California: Sage.

Cunningham, D. J., Duffy, T. M., & Knuth, R. A. (2000). *The Textbook of The Future*. CRLT Technical Report .No.14-00. Indiana University.

Denzin, N. K., & Lincoln, Y. S. 1994. *Handbook of Qualitative Research*. (ed.). Thousand Oaks. CA. Sage Publication.

Horton, W. (2001). *Evaluating e-learning Alexendaria, VA. American Society for Training and Development*.

Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education*. San Francisco: Jossey-Bass Publishers.

Ministry of Education, MOE. (2015). *Panduan Pelaksanaan Sains, Teknologi, Kejuruteraan dan Matematik (STEM) dalam Pengajaran dan Pembelajaran*. Bahagian Pembangunan Kurikulum. Putrajaya.

Ministry of Education, MOE. (2016). *Panduan Pelaksanaan Sains, Teknologi, Kejuruteraan dan Matematik (STEM) dalam Pengajaran dan Pembelajaran*. Bahagian Pembangunan Kurikulum. Putrajaya.

Mohd Yusof Othman. (2017). *Peradaban Islam Teras Transformasi Nasional. Jurnal Hadhari (Edisi Khas). Institut Islam Hadhari*. Universiti Kebangsaan Malaysia. Bangi, Selangor, Malaysia. 11-19.

Needham R. (1987). *CLIS in the Classroom. Teaching Strategies for Developing Understanding in Science*. Leed. University of Leed.

Nor Azlina Ahmad. (2015). *Kesediaan Guru Dalam Pendidikan Integrasi Sains, Teknologi, Kejururteraan, dan Matematik, STEM*. Universiti Sains Malaysia, USM.

Norijah Mohamad. (1997). *Keberkesanan Pembelajaran Koperatif dan Pengajaran Secara Modul Bagi Peningkatan Pencapaian Pelajar Dalam Bahasa Melayu Peringkat Sekolah Menengah*. Tesis sarjana yang Tidak Diterbitkan. Universiti Putra Malaysia.

Ong Eng Tek, Yeam Koon Peng. (2003). Pengajaran Sains Berteraskan Pandangan Konstruktivis Terhadap Pembelajaran. The Classroom Teacher. (Jilid 8). Bil. 1. Pulau Pinang. *Pusat Serantau Pendidikan Sains dan Matematik, SEAMEO*. 113-120.

Patton, M. Q. 1990. *Qualitative Evaluation and Research in Methods*. 2nd Edition. Newbury Park. CA: Sage.

Pope, C., & Mays, N. (1995). Qualitative Research. Reaching the Parts Other Methods Cannot Reach: An Introduction to Qualitative Methods in Health and Health Services Research. *British Medical Journal. 311*. 42-43.

Robinson, R. D. (1972). The Development and The Multinational Corporation. *The ANNALS of the American Academy of Political and Social Science. 403*(1). 67-69. doi 10.1177/000271627240300110 7.

Saldaña, J. (2015). *The Coding Manual for Qualitative Researchers*. Sage, Thousand Oaks, CA.

Shirley Tay Siew Hong. (2007). *An Evaluation of Teaching and Learning of Science in English in A Rural School in West Coast of Sabah*. PhD Thesis. Universiti Malaysia Sabah, UMS.

Trochim, W. M. K. (2006). *Introduction to Evaluation*. Retrieved on 13th December 2017 from http://www.socialreserachmethods.net/ kb/intreval.htm

Tuckett, A. (2004). Qualitative Research Sampling: The Very Real Complexities. *Nurse Research. 12*(1). 47-61.

Worthen, B. R., & Sanders, J. R. (1987). *Educational Evaluation: Alternative Approaches and Practical Guidelines*. White Plains. NY: Longman.