DEVELOPMENT OF NUTRI-STEM MODULE FOR FORM TWO SCIENCE TEACHERS

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ABSTRACT

The main aim of this research was to develop a valid and reliable "Nutri-STEM" module using Project-based Inquiry Learning (PIL) method based on Sidek's model. Science teachers' perception towards the suitability of content, suitability of activities, interface compatibility and usability of "Nutri-STEM" module were investigated. Quantitative approaches and survey design were used in this research. A number of 48 science teachers were selected using random sampling method from a population of 65 science teachers in one of the districts in Perak. The validity and reliability of the "Nutri-STEM" module were measured using Average Congruency Percentage (ACP) and Cronbach's alpha respectively. A set of questionnaire was used to investigate science teachers' perception towards suitability of module's content, suitability of activities, interface compatibility and usability of the module. The data obtained was analysed using the "Statistical Package for Science Social" (SPSS) to measure the percentages and mean. Findings showed that "Nutri-STEM" module has high validity and reliability value which are 81.34% and 0.934 respectively. Science teachers' perception towards the four constructs in the questionnaire gained the mean of 4.30, 4.35, 4.45 and 4.26 respectively. As a conclusion, a valid and reliable "Nutri-STEM" module was successfully developed and gained positive perception from science teachers towards its content and activities' suitability, interface compatibility and usibility. This research implicates the development of "Nutri-STEM" module is capable to provide science teachers an extra proper reference for STEM education thus gives them clear information on teaching and learning STEM classes.

PEMBANGUNAN MODUL NUTRI-STEM UNTUK GURU SAINS TINGKATAN DUA

ABSTRAK

Tujuan utama penyelidikan ini adalah untuk membangunkan modul "Nutri-STEM" yang sah dan boleh dipercayai menggunakan kaedah *Project-based Inquiry Learning (PIL)* berdasarkan model Sidek. Persepsi guru sains terhadap kesesuaian kandungan, kesesuaian aktiviti, kesesuaian antara muka dan kegunaan modul "Nutri-STEM" juga disiasat. Pendekatan kuantitatif dan reka bentuk tinjauan digunakan dalam penyelidikan ini. Seramai 48 guru sains dipilih daripada seramai 65 orang populasi guru sains menggunakan kaedah persampelan rawak daripada salah satu daerah di Perak. Kesahan dan kebolehpercayaan modul "Nutri-STEM" diukur dengan menggunakan *Average Congruency Percentage (ACP) dan Cronbach's alpha* masing-masing. Satu set soal selidik digunakan untuk menyiasat persepsi guru sains terhadap kesesuaian kandungan modul, kesesuaian aktiviti, kesesuaian antara muka dan kegunaan modul. Data yang diperoleh dianalisis menggunakan "*Statistical Package for Science Social" (SPSS)* untuk mengukur peratusan dan min. Hasil kajian menunjukkan bahawa modul "Nutri-STEM" mempunyai nilai kesahan dan kebolehpercayaan yang tinggi iaitu 81.34% dan 0.934 masing-masing. Persepsi guru sains terhadap empat konstruk dalam soal selidik masing-masing memperoleh min 4.30, 4.35, 4.45 dan 4.26. Sebagai kesimpulan, modul "Nutri-STEM" yang sah dan boleh dipercayai berjaya dikembangkan dan mendapat persepsi positif daripada guru sains terhadap kesesuaian kandungan, kesesuaian antara muka dan kegunaannya. Penyelidikan ini mengimplikasikan pembinaan modul "Nutri-STEM" memberi guru sains rujukan tambahan untuk pendidikan STEM. Justeru, memberi mereka maklumat yang jelas mengenai pengajaran dan pembelajaran kelas STEM.

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LIST OF ABBREVIATIONS

ACP	Average Congruent Percentage
IBL	Inquiry Based Learning
KPM	Kementerian Pendidikan Malaysia
PBL	Problem Based Learning
PIL	Project-Based Inquiry Learning
PPPM	Pelan Pembangunan Pendidikan Malaysia
STEM	Science, Technology, Engineering and Mathematics

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The Malaysian Education Blue Print 2013-2025 was successfully developed and launched on 6th September 2013 (Kementerian Pendidikan Malaysia, 2013); an effort to improve Malaysia's international education status. One of the indicators for a country to be considered as developed is the number of researchers yet the number of researchers in Malaysia is still below the requirement to be a developed country (MASTIC, 2015). In order to attract people into the field of science, one of the initiatives taken by the Ministry of Education is the implementation of STEM education, thus STEM education is also one of the focus in the Malaysia Education Blue Print 2013-2025 (Kementerian Pendidikan Malaysia, 2016). A well-planned STEM

education is able to enhance students' knowledge, creativity and innovation as well as competitive ability. Hence, a proper reference for teachers in teaching and learning STEM is believed to give teacher a helping hand and attract students' attention toward STEM field and career in the future (Kementerian Pendidikan Malaysia, 2016).

1.2 Research Background

Trends in the International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) are two international exams that aimed to investigate the standard of students and curriculum in a country (Shi, He, Wang, Fan, & Guo, 2016). Both TIMSS and PISA share one similarity where both of these examine students' capability in Science and Mathematics. The result obtained from TIMSS and PISA review the educational level of students in a country and standard of the curriculum. Hence, this gives a country to review and enhance the current curriculum and teaching pedagogy in order to meet the international benchmark.

Malaysia began participating in TIMSS and PISA in 1999 and 2009 respectively (Ministry of Education of Malaysia, 2013). Science subject of Malaysia showed a score below the average in both TIMSS and PISA, this indicated an intervention was needed to improve the Science syllabus. According to Abdul Halim, Nur Liyana and Marlina (2015), questions in TIMSS and PISA include higher order thinking skills (HOTS), analysis, synthesis and involve application to daily life. A traditional teaching and learning classroom is no longer sufficient to shape a student with high competency in the field of science, technology, engineering and mathematics. As a result, the Ministry

of Education Malaysia introduced STEM education in the Malaysian Education Blueprint (2013-2025) (Kementerian Pendidikan Malaysia, 2013).

STEM is the abbreviation to Science, Technology, Engineering and Mathematics. STEM education opens a new era in teaching Science, Technology, Engineering and Mathematics by integrating these four disciplines as a whole based on real life applications (Stohlmann, Moore & Roehrig, 2012). For example, in science classes, teachers need to blend the concept of Technology, Engineering and Mathematics in the lesson rather than teaching Science alone. According to Thibaut et al. (2018), integration of these subjects enables students to explore, analyse and synthesise knowledge and apply it to the real-world context. In the Malaysian Education Blueprint (2013-2025), the Ministry of Education emphasises on the following aspects on STEM education:

i) Students-centred teaching and learning process

ii) Higher order thinking skills

iii) Application of STEM in daily life

iv) Increasing percentage of critical thinking and problem-solving questions in exam

With the implementation of STEM education, the traditional chalk and talk science classroom needs to be abandoned and replace with an active classroom.

Teaching approach plays a crucial role to integrate STEM education in science subject effectively; a teacher with good teaching strategies will definitely help students to connect knowledge among the four elements in STEM. Stated by Jacob and Hayirsever (2016) stated in their study, student-centred approach is one of the branches under constructivism, in which students learn by constructing their own knowledge. In student centred learning approach, teacher acts as a facilitator to guide students along the learning process.

Module-based teaching is another teaching approach that can be implemented by science teacher to integrate STEM education in the class. According to Sidek and Jamaluddin (2005), module is a printed material with details of lessons, suggestions of activities, guidelines and notes to ease the teaching and learning process for both teachers and students. Hence, developing a module based on student-centred approach seems to be a good way to integrate STEM education in the Science subject.

1.3 Problem Statement

The main problem to be studied in this research is the lacking of proper references for STEM education (Junainah Jamaludin, Lay, Khan, Khoo & Leong, 2020; Margot & Kettler, 2019; Shernoff, Sinha, Bressler & Ginsburg, 2017). Problems arose when teachers do not have proper STEM reference to refer to when they need to conduct STEM lessons.

Integrating STEM in the science subject is not merely adding technology, engineering and mathematics elements in the lesson; there are procedures to follow in conducting STEM education. Without proper and formal references, teachers could only teach STEM education based on their own understanding (Margot & Kettler, 2019). Teachers need a proper STEM reference to lead them in choosing a suitable STEM teaching method and integrate science concept simultaneously (Junainah Jamaludin et al., 2020).

Shernoff et al. (2017) also stated insufficient STEM resources and instructional material affects science teacher's readiness to conduct STEM classes. They mentioned, science teachers are not ready to implement STEM education because they are not confident to teach subjects that are not within their field. In STEM education, science teacher would need to integrate technology, engineering and mathematics in the lesson. These teachers have doubts in planning the lessons and choosing appropriate learning activities since STEM involves subjects that are beyond their expertise field.

Employment of module in the teaching process could guide teachers in conducting the lesson as module contains content, activities and clear instruction for the users (Sidek & Jamaluddin, 2005). A research done by Aliza Ali (2015) also showed module-based teaching improves teacher's performance and help them to conduct lesson in a more effective and professional way. Hence, a module seems to be a proper reference that could integrate STEM concept in the science classroom.

Project-based inquiry learning (PIL) is a STEM teaching and learning method developed by Aminah Ayob, Nasir Ibrahim, Ong and Mazlini Adnan in 2017. PIL was

chosen as the teaching and learning method in "Nutri-STEM" module as it integrates project-based and inquiry-based learning, making it as a comprehensive method in teaching and learning STEM (Aminah Ayob et al., 2017). In the study of Ng and Mazlini Adnan (2018), teaching STEM education using PIL showed a positive result. Teachers also reflected stages in PIL are capable to guide them in integrating STEM in the science subject; they also commented that integrating STEM through PIL enriched their content knowledge and implementation skills of STEM (Ong et al., 2016).

According to Kementerian Pendidikan Malaysia (2015), an analysis of past Malaysian Certificate of Education showed students have difficulty in answering questions regarding nutrition. Students were not able to master the analyzing and application level as stated in Bloom's taxonomy for the nutrition chapter. One of the reasons is because of the diversity of this chapter; there are many subtopics and complex processes that require students to learn in this chapter (Kementerian Pendidikan Malaysia, 2015). Thus, the researcher had chosen the chapter "nutrition" in Form Two science as the content for "Nutri-STEM" module. This decision was supported by need analysis (table 4.1) conducted by the researcher during the pilot test.

Obviously, previous studies have proven that there is a conflict between inadequate STEM references and students' weakness in the chapter of nutrition. In order to solve these problems simultaneously, the researcher decided to create "Nutri-STEM" module using PIL method to aid teachers in conducting STEM classes that integrates the concept of nutition.

1.4 Conceptual Framework

In this research, STEM module is developed based on the constructivism theory which included in the Project based Inquiry Learning (PIL) STEM model 2017 (Aminah Ayob et al., 2017). The researcher refers to Sidek's model (Sidek, 2001) for STEM module development. The independent variable involved in this research is the STEM module on the topic of nutrition in Form Two Science. The dependent variables are the validity and reliability of the STEM module as well as Form Two Science teacher's perception on the STEM module. Figure 1.1 shows the conceptual framework of the research.

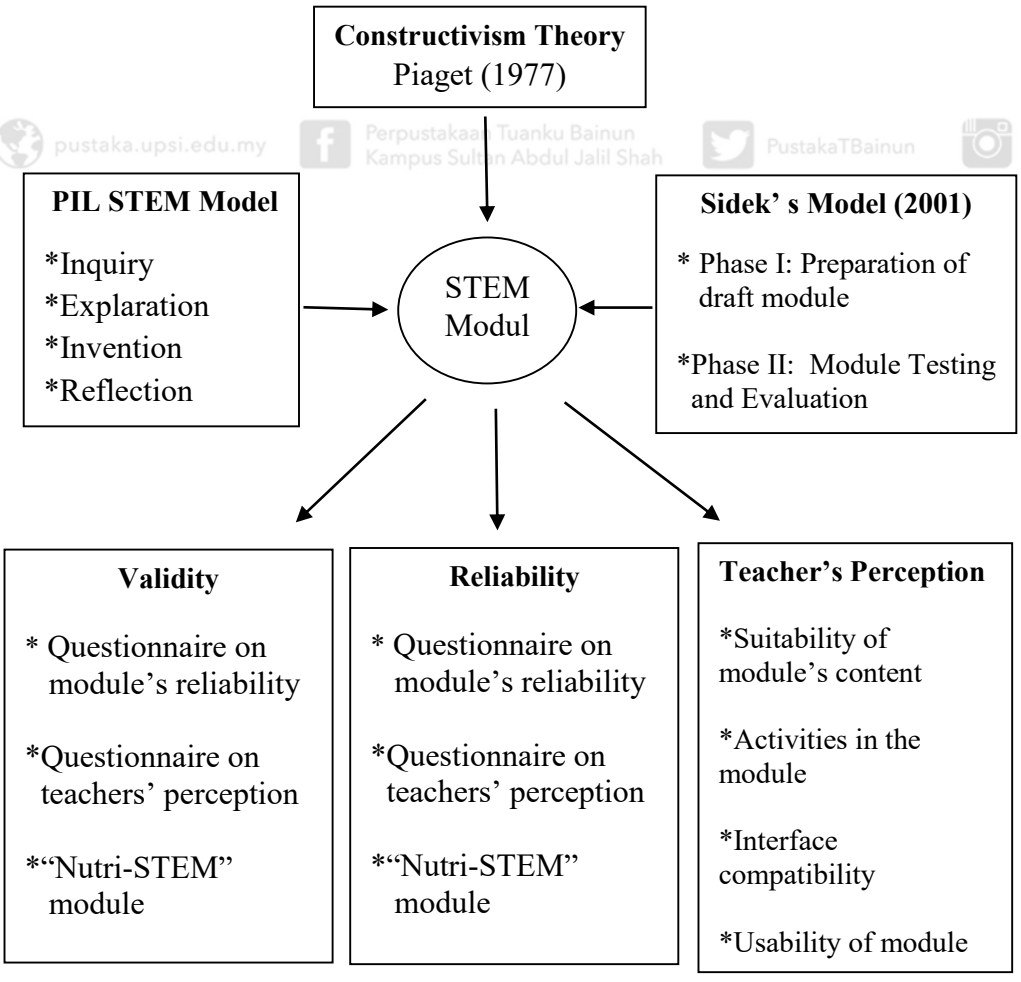

Figure 1.1. Conceptual Framework in Research

1.5 Research Objectives

The aim of this research is to:

i) Develop a valid and reliable "Nutri-STEM" module on the topic of nutrition for Form Two science teacher.

ii) Investigate Form Two science teachers' perceptions towards suitability of content, suitability of activities, interface compatibility and usability of "Nutri-STEM" module.

1.6 Research Questions

i) What are the validity and reliability of the developed "Nutri-STEM" module?

ii) What are science teachers' perceptions towards suitability of content, suitability of activities, interface compatibility and usability of "Nutri-STEM" module?

1.7 Significance of Research

The purpose of this research is to develop a STEM module in the topic of nutrition in Form Two Science. The developed STEM module may give new ideas on teaching and learning STEM education in science subject to several parties including curriculum composers, teachers and students.

The initiative of the Ministry of Education to implement STEM education is not align with the current Science curriculum; teachers and students could not see STEM education explicitly in the current Science curriculum (Muhammad and Finly, 2016). Initiatives to implement STEM education should be in line with a curriculum that is fulfilled with STEM elements. Hence, this STEM module hopes to give curriculum composer some ideas on the integration of STEM elements in the content, teaching pedagogy, activities and assessment in the future of science curriculum.

Amadio (2015) stated in his research, another issue reflected by teachers regarding STEM education is the inadequate references materials. In the Malaysian context, science teachers are facing the same circumstances where they hope to have more extra references modules to guide them in conducting STEM education in the Science classroom (Aini Aziziah et al., 2014). The "Nutri-STEM" module developed in this research can be added in the reference list for teachers to implement STEM education in the classrom. Proper references can help Science teachers to conduct STEM education without hesitation; eventually students will be benefited from this module where they will have a clear idea on the integration of science, technology, engineering and mathematics.

1.8 Limitation of Research

This research was carried out in one of the districts in Perak. All the secondary schools in the district were involved in this research; science teachers were chosen randomly from each school. Since the respondents only represent the teacher population in the

districts, hence the results obtained from this research could not describe the whole population of the state or nationwide. The topic chosen to develop the STEM module is Nutrition in Form Two Science. Hence, the finding of this research could not be said the same of the other chapters in Form Two Science. Another weakness in this research is the researcher did not investigate the effectiveness of the module; the researcher only investigates teachers' perception on the "Nutri-STEM" module.

1.9 Operational Definition

Different individual will have different understanding about some words and phrases used in this research, an operational definition would be helpful in explaining the meaning of the terms used in this research. The operational definitions are listed below:

STEM

STEM is the integration of science, technology, engineering and mathematics in education to help learners to apply these content knowledges in real life situation (Ostler, 2012). In this research, STEM refers to the integration of science, technology, engineering and mathematics in science classes.

Module

Module is a set of teaching and learning material enriched with components like objective, activities, assessment and a systematic guideline for both teacher and students to follow in order to master a particular topic (Sidek and Jamaludin, 2005). In

this research, module refers to a reference material on the topic of nutrition in Form Two Science.

Perception

Perception is a process of cognition in the brain that show series of action like relate, evaluate and detect information (Wang, 2007). In this research, perception refers to Science teachers' opinion regarding the perceived usefulness of the STEM module.

Validity

Validity in this research refers to to what extend the experts approve the content of questionnaire on module's reliability, questionnaire on teachers' perception and "Nutri-STEM" module.

Reliability

Reliability in this research refers to the ability of questionnaire on module's reliability, questionnaire on teachers' perception and "Nutri-STEM" module to produce consistent measurments.

1.10 Conclusion

In conclusion, the main purpose of this research is to develop a STEM module for Form Two science teachers in one of the districts in Perak. With regards to the aim of the research, two research questions were formed to be answered in the research with the guidance of a validated and reliable instrument. A proper STEM reference should be given to science teachers to aid their teaching in STEM education.