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Students Learning Needs in Science Form One

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Abstract

This study discusses the step by step in building the STEM Inspirational Module. This research uses a purposive sampling technique that collecting data from panel of expert (lecturer), six teachers and 20 students. Research instruments used are questionnaires and structured interviews conducted to both teachers and students. Data were collected and mean analysis and percentages were carried out. The findings show that educational innovation can help teachers overcome the time constraints in designing lesson plan with STEM Activities. STEM Inspirational Module Kit is easy to handle and is readily available for teachers to use. Furthermore, the modules are based on low cost and easy-to-use materials and tools.

Keywords

Science, Module, STEM

1. Introduction

Globalization has been circulated with the advancement of Science and Technology. In this regard, the individual's knowledge and skills should evolve in tandem with the current changing of Science and Technology. Science curriculum aimed at cultivating interest and developing students' creativity through experience and investigation to master the science and technology knowledge and skills as well as scientific attitudes and values to enable them to solve problems and make decisions in their daily lives (DSKP, 2016). Thus, Science-Technology-Engineering-Mathematics (STEM) was introduced and becomes the focus on the economic and future discussions of the country. This situation certainly affects the development of human capital in science education.

However, in reality only a small number of 18% of Malaysian children have a limited knowledge of science concepts and skills in the classroom (Martin et al.,

2012). In the meantime, the research group also noted that 55% of them had limited existing knowledge in science. In addition, there is a scientific achievement gap between different pupils of socio-economic status. Students from families with high socio-economic status have better science and mathematics achievement than those with low socio-economic status families (Navarro, Flores, & Worthington, 2007).

Therefore, educational innovation needs to be systematically developed to increase science achievement according to the currents changes in curriculum and student's needs. To develop learning module that suitable for Malaysian High school Standard Curriculum there is a need for systematic investigation. Research is a form of systematic investigation, and in education it involves an empirical process using systematic methods (Springer, 2009). Research development requires a variety of research methodologies, research tools, and summative assessments implemented through experimental designs (Richey & Klein, 2014). This step is taken to document the module development procedures systematically and regularly. This paper will discuss the findings on students' learning needs in science form one.

2. Research Aims

The purpose of this study is to discuss students' learning needs in science form one in developing the STEM Inspirational Module. The theory and method of implementation of STEM activities are described in detail through the proses of Analysis phase and Design Strategy phase.

3. Innovation of the STEM Inspirational Module

To develop STEM Inspirational Module, the researchers conduct the analysis of needs and the development of an effective delivery system to meet the teaching needs. This is to ensure that the development of materials and teaching activities will support the reflective learning activities and assessment practices implemented by students that eventually will create active and constructive learning processes (Koneru, 2010).

The Analysis Phase

Analysis of the learners and their learning environment are vital for instructional design (Koneru, 2010). In this phase, researchers analyze the learning environment, identifies students' profiles as well as researcher's experience (Richey & Klein, 2014). In addition, this phase also involves reviewing the literature for the purpose of identifying the solutions to be tested in an investigation (Alias, 2007).

Assessing learning or instructional need is a process of identifying the gap between what is and what needs to be, thereby, finding how to remedy the lack, whether it is knowledge or skills (Koneru, 2010). In this context, one of the researchers started by identifying Form One Science Learning problems in schools

and adapted it to the research paradigm. In this research, the researchers employ Post-positivist Paradigm. The researchers began with identifying the ontologies that involved in the Science Curriculum, school's environment, teachers' and students' perceptions of science.

The researchers conducted Learners' Analysis. This is done to determine the instructional goals and anticipated outcome can be decided by the analysis of learners and their knowledge and skill gaps (Koneru, 2010). The results of the analysis show that the problems faced are the low achievements of students in TIMSS and PISA and also the lack of student participation in science stream. Later, the researchers examined the epistemological aspects that involve in generating knowledge. As such, the researchers examine the factors that influence the low achievements in science subjects and their proposed solutions.

This phase involves the process of teaching strategy formulation as well as the product design that are based on the analysis of the journals (Richey & Klein, 2014; Alias, 2007). In the context of this research, the Design phase involves the development of the theory that is the principle of design in the construction of the STEM Inspirational Module. The principles of the module development design are obtained and collected as a result of the analysis of the literature. The key points of the analysis will be included in the development of the Learning Needs Analysis questionnaire that distributed to the students.

4. Methodology

Adhering to the Post-positivist paradigm to find cause-and-effect relationships, the researcher conducted a quantitative study. The quantitative approach was chosen because it has a minimal degree of ambiguity and focuses on results (Creswell, 2002). This study uses purposive sampling techniques to collects data that consist 20 students. Face validity is obtained from a panel of experts to ensure students readability and understanding of items in research instruments. Selecting panel of experts is crucial to the target audience (Jones, Gwynn, & Teeter, 2019). This panel of experts must have the skills to determine which method is more appropriate for young children as opposed to gathering data from older teens. This is in line with Creswell & Creswell (2017) that mentioned for stakeholders to provide a source for answering pertinent questions. This eventually will lead to answers and solutions and help the researcher to develop learning module.

5. The Findings and Discussion

In the Analysis Phase, the initial step begins with defining the students' needs. These needs are important to be addressed before developing a learning module. Table 1 shows the analysis findings of 20 students.

The related literatures of the aspects that affecting academic achievement in science subjects are used to build questionnaire items for Learning Needs Analy-

sis. The questionnaires were developed using Likert Scale of five points i.e.; Strongly Disagree, Disagree, Moderately Disagree, Agree and Strongly Agree. The data collected in this research were interpreted to three parts, negative (scale 1.00 - 2.99), moderate (3.00 - 3.99) and, positive (4.00 - 5.00).

Item 1 shows that some students have negative perception towards the science subjects, they mentioned that the science subjects are difficult to understand (m = 2.65, SD = 0.93). However, majority of the students agree with Item 2 which stated that students want to improve their achievement in this subject (m = 4.65, SD = 0.59). This finding supports the pervious report by TIMSS that found the students' attitudes and values for science and mathematics were high (Mullis & Martin, 2017).

Table 1. Students' learning needs analysis.

No.	Item	Mean	SD	Interpretation
1	Science subjects are easy to understand.	2.65	0.93	Negative
2	I want to improve my achievement in science subjects.	4.65	0.59	Positive
3	I like to go to science learning classes.	4.10	0.64	Positive
4	I like activities that use low-cost and easy-to-find materials from home.	4.50	0.61	Positive
5	I like to perform activities in groups.	4.20	1.06	Positive
6	I like to share the experience of creating a project with another friends.	4.20	0.62	Positive
7	I love active learning classes.	4.40	0.60	Positive
8	I like activities that allow me to be creative.	4.25	0.64	Positive
9	I like activities that allow me to try new ideas.	4.30	0.57	Positive
10	I like to carry out activities such as discussion, practical or experimental.	3.90	0.79	Moderate
11	I like to join contest such as creating paper aircraft.	4.20	1.00	Positive
12	I like science activities that involve calculations, measurements, and patterns.	3.55	0.69	Moderate
13	I like science activities that involve the knowledge of designing, inventing and producing new products.	4.30	0.80	Positive
14	I like science activities that encourage problem solving skills.	3.60	0.60	Moderate

Moreover, in Item 3 the students were positive with the statement that "I like to go to the science learning class" (m = 4.10, SD = 0.64). This showed that, student engagement is good and it play important role in the learning outcome of the practical activity. Practical activities can bring the positive effects of practical learning all depend on the pedagogical quality of the activities, and how the students process the new knowledge they obtain through this teaching (Gya & Bjune, 2021).

Education is for all; these includes both students with high socio-economic background as well as students with low socio-economic background. From the analysis of Item 4, it was found out that the students strongly agreed to the statement that activities need to use low-cost and easy-to-find materials from home (m = 4.50, SD = 0.61). Designing such activities requires flexibility enough to adapt to all the different students home situations for all to be able to achieve the same learning outcomes (Gya & Bjune, 2021). From literature review, there are few examples of such at-home DIY experiments for example in physics (Turner & Parisi, 2008), and chemistry (Gendjova, 2007). This show that, the are many ways to design practical activities that can supplement laboratory experiments and its learning objectives.

These aspects should be notable because the researchers are reviewing the reports of Christensen, Knezek, & Tyler-Wood (2014) that states the low-income families have lack basic skills in Science, Technology, Engineering and Mathematics. Moreover, the poverty in Sabah was the highest in the country with a records value of 2.8% compared to Sarawak 0.6% and Kuala Lumpur, Johor, Malacca and Selangor that were zero poverty (epu.moe.my). Thus, to helps teachers conduct STEM activities for all the kids with no regards of theirs' socio-economic background, the researchers develop module that used low-cost materials and readily available tools that can be found around students' environment for example mineral bottle, boxes, vinegar and so on.

Furthermore, the researchers looked into students' social needs. In Item 5 shows that students like group activity (m = 4.20, SD = 1.06). This finding replicated in Item 6 which shows that most of the students likes to share experiences with theirs' friends (m = 4.20, SD = 0.62). This is important because the interactions and behaviors among peers can encourage students' learning (Britner & Pajares, 2006).

In addition, Item 7 shows that almost all students demonstrate positive respond towards active learning (m = 4.40, SD = 0.60). Active learning positions students to experience greater levels of autonomy via an environment in which the instructor effectively supports that increased autonomy (Patall et al., 2019).

This finding is in line with the student's agreement on Item 8 which states that they like activities that allows freedom in creativity (m = 4.25, SD = 0.40). On one hand, there are the "cookbook" laboratories where students mindlessly following the protocol. Following the "cookbook recipe" without being engaged in the learning situation, they will not gain the same outputs as students who are more involved in the decision-making of the learning activities (Brownell et al., 2012). This is important because creativity helps students to find relationships

between new knowledge and existing knowledge (Henson, 2015).

Moreover, in Item 9 the students also agree with the statements that they like to try new ideas (m = 4.30, SD = 0.93). The student-active learning in practical activities will lead them to pose novel questions, find new results thereby making new discoveries to the scientific field (Aikens, 2020). To supports students' needs, the researchers will develop module based on Constructivist Approach. This is because, the approach of Constructivism aims to create learnings' excitement and produces creative students (Henson, 2015). Thus, this research aims to develop learning module that can engage the students by facilitating autonomy during learning session.

Additionally, in Item 11 it is found that the students like to join competition (m = 4.20, SD = 1.00). However, Item 10 indicates that the students are less likely to carry out discussions, practices and experiments (m = 3.90, SD = 0.79). This is because students with low cognitive skills have found that learning based on inquiry is difficult (Kuhn et al., 2000). Therefore, the activities in STEM Inspirational Module are complemented with image of the product to help the students gain an initial idea and apply concepts knowledge in creating an innovation of their learning products.

This research also investigates students' needs that related to mathematics. In Item 12 students showed a moderate response to activities that involve calculations and arranging patterns (m = 3.55, SD = 0.69). On the other hand, Item 13 shows that the students positively agree to the statement that they like science activities that involve designing, creating and producing new products (m = 4.30, SD = 0.80). From this active learning, the students can gain skills and competencies related more to an authentic science experience and thus better prepare the students for work-life (Hole, 2018).

However, in Item 14 students were found to be moderately agree in the activities that involve problem solving skills (m = 3.60, SD = 0.60). To address this issue, the proposed STEM activity should integrate mathematical knowledge and engineering knowledge to help students to understand the importance of these knowledge in everyday life and its relationship to science and technology knowledge.

Strategic Design Phase

The researchers discussed the implementation of Strategy Design Phase. The structured interviews are conducted on five students. Interviews conducted to the students to give them an opportunity to explain theirs' opinions about the STEM Inspirational Module. Below is the summary of the interviews with the students.

The findings in **Table 2** shows that students agree with the statement that materials and tools used in STEM Activities are easily available and low in cost. Students also state that they can complete the activity with the guidance of module. Furthermore, students agree that this activity encourages them to actively engage in a group work. Moreover, the students agree that this activity encourage creativities and supports the freedom to test new ideas.

Table 2. Students' learning needs analysis.

Item	Students' Responses
Examples of materials and tools	Among the activities that are often noted by students are Water Filter activities (stone, sand, tea bags, rubber bands, and cotton) and Fire Extinguishers (baking powder, tissue, rubber band, and vinegar). These materials can easily be obtained from home.
Implementing STEM activities	Students explained that they can conducted and completed STEM Activity with the helps of module that act as guidances. Among the mentioned activities are Notes File, Fire Extinguisher, Straw Rocket, Water Filter, and Solar Cooker.
Active engagement	Students mentioned that STEM activities help them to actively involve in the preparation of materials. In addition, this activity also encourages discussion. A student states "this activity enhances the skills in group work".
Encouraging Creativity	All students agree to this statement. Examples of student responses are "Yes, because this activity produces new products."
Freedom to test new ideas	The student agrees with this statement. Among the students' responses are "This activity gives freedom to test new ideas such as in Water Filter activiti, the students can modify the arrangement of rocks and sand in the filter funnel".
The list of activities that supports and enhances daily problem-solving skills.	Among the activities students choose are Notes Files, Water Filters, and Solar Cookers.
Suggestions for creating excitement.	All students agree that the outcome of the learning should be exhibited to others. Examples of student responses are "produced product can be displayed on a school science day and it can also be contested between classes".

However, when doing practical works, it was found that students were not given the opportunity to explore and create their own understanding of the phenomena studied (Pyatt & Sims, 2007). This is because most of the Science Laboratory activities are teacher-centered expository and activities are carried out according to the steps that have been provided under the supervision of teachers. This means that the practical activities are merely confirming the theory and does not give students the freedom to generate and express their own opinions.

Thus, the obstacle in STEM integration needs to be addressed to ensure that

the implementation objectives of the STEM Inspirational Module are achieved. Among the proposed activities are Water Filters, and Solar Cookers. Students also agree that the outcome of learning products should be exhibited during School Science Day's.

6. Conclusion and Implications of Study

The theories and practices of each of the STEM disciplines can be applied to the everyday lives of students, in which they may directly experience the science in the world (Lombardi et al., 2021). By doing this, the students are able to engage sensory in learning process. Practical learning experiences provide opportunities to engage multiple senses as you touch, smell and observe a study object or phenomenon, which creates a new way of knowing the theory by increased sensory and cognitive activity (Nabors et al., 2009). By including both vision, hearing, touch, and smell, students can easily link the previous knowledge and thus help them to adapt or assimilate the new knowledge into an existing framework.

Overall, it can be concluded that the steps in research design is important in ensuring that researchers set a focus on meeting the mission needs to produce educational innovations that are able to integrate STEM through the 5E Learning Cycle in conceptualized guided inquiry.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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