Conference Paper

The Development of a COVID-19 STEM Module Based on the Inquiry Approach for Early Childhood Education

Noraini Said, Connie Cassy Ompok, and Phreoza Dayzency Missie

Faculty of Psychology and Education, Universiti Malaysia Sabah, Sabah, Malaysia

ORCID:
Noraini Said: http://orcid.org/0000-0002-9928-6509

Abstract

Many scholars have agreed that early childhood is a crucial stage in terms of a child's physical, intellectual, emotional and social development. Therefore, it is imperative for all stakeholders to ensure good quality early childhood education for our future generations by promoting essential skills and content, especially in preparing children to cope and live with the new norms after COVID-19 struck worldwide. In this design-based study, we report on the development of a COVID-19 STEM (Science, Technology, Engineering and Mathematics) module specifically targeted for early childhood education based on the first three phases of the ADDIE (Branch, 2009) instructional model: Analyze, Design and Development. In the Analyze phase, we conducted a needs analysis by involving parents, teachers and children, and document analyses of teaching documents and standards. In the Design phase, we performed task inventory and composed performance objectives by incorporating multiple themes of the inquiry approach, COVID-19, STEM and moral reasoning. In the Develop phase, we generated content, developed supporting strategies, and conducted formative revisions. 10 lesson units were produced by focusing on COVID-19 essentials such as self-hygiene and preventative measures. STEM themes are mainly highlighted by the scientific experiments that the children carry out during lessons. All activities planned are inquiry-based to ensure better understanding of the topic. Moral reasoning is also embedded into all units by highlighting the moral values. It is hoped that the COVID-19 STEM module will better prepare our future generations through the combination of all four main themes.

Keywords: COVID-19, early childhood education, STEM, ADDIE instructional design, inquiry-based

Corresponding Author:
Noraini Said
noraini_said@ums.edu.my

1. Introduction

Early childhood education is an integral part of the education system as it is the first phase of transition for children to formal education. In Malaysia, the pre-school education policy (1996) was introduced to regulate the pre-school institutions in order to provide

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equal access of education to all children ranging from 4 to 6 years old regardless of socio-economic background, race, and disability. The pre-school education providers are also obliged to conform to the National Preschool Curriculum Standard (KSPK) 2017 to prepare pre-schoolers not only with reading, writing, counting and reasoning skills but also to produce a well-balanced person physically, emotionally, spiritually and socially.

However, the landscape of education is not always constant and stable. A lot of external factors can directly impact the implementation and delivery of instruction which affects the quality of education. For instance, the recent global catastrophe of COVID-19 has seen children all around to world to miss schools due to fears of being infected. Students either attend classes via online instruction which is widely adopted to make up for the conventional face to face interaction in teaching and learning or be informally taught by their parents or caretakers at home. In addition, there is also a growing awareness on hygiene and social distancing as a vital preventive measure to fight off COVID-19.

With regard to pre-school curriculum in Malaysia, moral values (spirituality, attitude, and values) and STEM are two out of the six strands specified in KSPK 2017. Given the multiracial context of Malaysia, the implementation of moral values is seen as an effort to safeguard the harmonious mingling of people from increasingly diverse cultural, social, religious, and traditional backgrounds. The STEM strand is vital in preparing children to cope with the current and future world of rapid science, technological advancements and globalization that are contributing to the complexities of social life. Though KSPK 2017 specifically outlines the domains that shape the knowledge and skills be taught to children, culturally appropriate modules for teaching children moral values and STEM related to COVID-19 in the local context of Malaysia are not readily found.

Therefore, this project is proposed to promote such values, as the goals of teaching are to help students understand and apply these values and to provide a safe and secure learning environment to explore values in new normal. In realizing this matter, Covid-19 STEM Module based on Inquiry Based Learning (IBL) is developed to raise awareness of global issues among children and helping them develop their moral reasoning indirectly though culturally appropriate STEM content.

Apart from that, this research approaches current issues such as COVID and STEM through Covid-19 STEM Module as it is expected to ignite children interest in learning STEM through inquiry approach and indirectly raising children with great value. Children learn science, mathematics and language, but at the same time, they learn how to coop-erate with each other by doing activities together, which instils the spirit of togetherness [1]. Simultaneously, it prepares students in the field of inquiry by identifying problems,

concepts, and methodologies as they engage students actively in the problem of the research.

The implementation of Covid-19 STEM Module is also in line with the Malaysia Education Blueprint 2013-2025 that is committed on developing the child holistically along intellectual, spiritual, emotional, and physical dimensions. The implementation of values aims at generating students who value moral and demonstrate commitment in instilling moral values towards future educational aspirations [2]. The inclusion of STEM theme can provide more relevant and open experience for the children as they are required to apply problem-solving skills as well as their knowledge about STEM content to relate their learning experience with real life activities [3].

Apart from that, Inquiry-Based Science Education (IBSE) has gained more attention in the science education in Malaysia [4]. Derived from inquiry learning, IBSE is aimed to enable learners to build a deeper understanding knowledge and discovery process in Science [5]. Besides, inquiry learning leverages on the exploration of the environment and motivates learners to conduct further queries to enhance their understanding and achievements. The four main elements in this module is hoped to provide the best instructional materials for the children.

The module is developed based on Branch [6] ADDIE, a comprehensive instructional design framework due to its clear and logical procedures in every phase of analyze, design, develop, implement, and evaluate. Besides, instructors who often do not play the role of designers, could benefit from the specific how-to-instructions, and actively participate in the design and development of an instructional learning tool or system. Apart from the benefit to instructors, this model also reinforces the reiterative nature of the ADDIE activities and phases which can guarantee continual improvement to the developed system. With all of these addressed, this study aims to answer the following questions:

1. What are the tasks and outcomes in the analyze, design, and develop stages?

2. What is reviewers' evaluation on the content and learning design of COVID-19 STEM module for early childhood education

2. Method

The study aims to develop a module that integrates multiple themes of COVID-19, moral values and STEM content by using inquiry approach for children. The study employs developmental research by adopting the ADDIE instructional model: (i) Analyze (ii)

Design (iii) Develop (iv) Implement (v) Evaluate [6]. The researchers adopt the design as different research methodologies can be utilized in different phases in developmental research. However, this study only presents the first three phases of ADDIE due to some limitations that we faced in this project. Since ADDIE is a reiterative process, data is collected through formative evaluations in the analyze, design and develop phases. Multiple qualitative sources such as document analysis and focus group discussions were used to obtain input to accomplish the tasks in each respective phase.

Apart from that, a module evaluation panel consisting of three (3) experts involved in the design and development of this module served as reviewers of the module to determine the extent to which the reviewers agreed. The reviewers evaluated the module using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) on whether they agreed or disagreed that the module met the criteria in terms of content and learning design using a questionnaire adapted from Susiana [7]. An additional set of open-ended questions were also included to get reviewers' recommendation to make the module more effective. The reviewers are experts in the subject matter of early childhood education program and STEM program. The experts have the following profile; (i) more than fifteen years in the field of expertise; (ii) active/retired members in the academic institution (iii) have developed instructional materials in their field of expertise; and (iv) have evaluated instructional materials in their field of specialization.

3. Results and Discussion

This section presents the findings in each respective phase of ADDIE in the development of COVID-19 STEM module for early childhood education.

3.1. Analyze

In Analyze phase, we conducted needs analysis by involving parents and teachers in focus group discussion, and document analysis of teaching documents and standards such as KSPK 2017 and two existing teaching modules. Results found that parents and teachers agreed that there is a strong need to teach children on COVID-19 particularly the preventive measures in curbing the spread of the contagious virus. Parents also expressed the need to have simple and clear activities which they can replicate at home, should classes be closed due to the pandemic. Teachers highlighted the need to have more authentic STEM content in the module which should be contextualized to COVID-19 pandemic.

Both parents and teachers also place high importance on instilling moral values during lessons. The document analysis on KSPK 2017 and modules saw discrepancy in terms of the weightage/allocation of content where the coverage STEM content is quite limited though it should have been given bigger portion based on KSPK 2017 under the Science and Mathematics strand. Apart from that, there is a lack of higher order thinking skills activities in the modules. The existing modules also lack COVID-19 theme related materials as it is new and therefore it is imperative to include it in instruction to better prepare the children to live in the new norms.

3.2. Design

In Design phase, we performed task inventory and composed performance objectives by incorporating multiple themes of inquiry approach, COVID-19, STEM and moral reasoning through all values listed in KSPK 2017. In this phase, we mapped our purpose statement, instructional goals, performance objectives and the tasks.

3.3. Develop

In Develop phase, we generated content, developed supporting strategies, and conducted formative revisions. 10 lesson units are produced by focusing on COVID-19 essentials such as self-hygiene and preventive measures. STEM themes are mainly highlighted by the scientific experiments that the children will carry out during lessons. All activities planned are inquiry-based to ensure better understanding of the topic. Moral reasoning is also embedded into all units by highlighting the moral values.

Fig. 1 shows Unit 5 of COVID-19 Module. Each unit consists 6 main units of Category, Title, Synopsis, Values, Theory and Materials needed to accomplish the tasks planned. Apart from the 10 units, there are also 2 additional parts of Inquiry-based thinking skills which are embedded in the use of visual and short texts to appeal to children.

After all units are compiled, we asked a panel of experts who served as reviewers to review our module in terms of content and learning design as part of the formative evaluation. Table 1 summarizes the evaluation on the content by three experts. The evaluation criteria included breadth/coverage of the topics / selected themes, matching between title and content, clarity of language, alignment between standards and objectives, and adequacy of content.

Based on the scale of 1 (strongly disagree) to 5 (strongly agree), the mean values of most items are more than 4 which indicate agreement. Only two items have lower

Figure 1: Sample Unit of COVID-19 STEM module

mean (item 5 and item 11). From the open-ended items, the reviewers remarked that more content and frequent reference to COVID-19 should be made. Besides, explanation for specific pictures should be further elaborated for the children to understand better. Table II shows evaluation done on the learning design of COVID-19 STEM module. Overall, all items received a mean value of more than 4.0 which indicate agreement. Only one item received 3.67 mean, and it was remarked that materials in the second part of the module, Inquiry-based thinking skills should be reorganized to ensure better flow and cohesion.

The reviewers' input is a valuable source and insights into the future revisions and improvements that can be made to the module. As ADDIE is reiterative, we can always add on the lacking areas before implementing it to the actual users of the module; teachers and parents. Overall, reviewers agreed that the module is appropriate and valid to serve its purpose in early childhood education.

TABLE 1: Reviewers' EVALUATION OF CONTENT

No	Content Evaluation		
	Item	Mean	Category
1	The accuracy of the unit title with the contents	4.33	Agreement
2	Conformity between concepts and content.	4.33	Agreement
3	Learning objectives.	4.33	Agreement
4	Conformity between learning objectives and material	4.33	Agreement
5	Clarity of material description. Clarity of examples used.	3.67	Agreement
6	Conformity between tables, charts, drawings / illustrations and material.	4.00	Agreement
7	The accuracy of the selection of summary content.	4.33	Agreement
8	Conformity between competency standards and learning objectives.	4.33	Agreement
9	Relevance of moral values to the Unit/Tasks	4.67	Agreement
10	Adequacy of STEM content and activities	4.00	Agreement
11	Adequacy of COVID-19 content and exposure	3.67	Agreement

TABLE 2: RevIEWERS' EVALUATION OF LEARNING DESIGN

No	Learning Design Evaluation		
	Item	Mean	Category
1	Cover quality	4.00	Agreement
2	The accuracy of typing layout	4.33	Agreement
3	Consistent use of spaces, titles, subtitles, and typing material	4.33	Agreement
4	Writing / typing clarity	4.67	Agreement
5	Completeness of the components in each chapter of teaching material.	4.33	Agreement
6	The accuracy of the way the material is presented	4.33	Agreement
7	The accuracy of placement of charts, tables, or images illustration	4.33	Agreement
8	Clarity of order of material presentation	3.67	Agreement

4. Conclusions and Suggestions

This study intends to develop a COVID-19 STEM module targeted to children in early childhood education program. We employed developmental research by employing Branch [6] ADDIE model and presented outcomes from the first three phases of (i)

analyze; (ii) design; and (iii) develop. Findings show that multiple themes were identified to be included in the module such as COVID-19, STEM, and moral values. Inquiry-based learning is adopted in the way the content is presented and tasks conducted. Result of the design stage mapped the alignment between the performance objectives, tasks and learning outcomes. At the develop phases, a module consisting 10 units was produced and evaluated by a team of experts / reviewers. The reviewers gave positive feedback with high mean values of agreement. Nevertheless, there are some areas that still require revisions and improvements such as the clarity of materials and description. COVID-19 STEM module shows a positive outlook in terms of experts' responses and it is potentially viable to be implemented in the early childhood education.

Acknowledgment

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