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ICT Society STEM Kit

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Abstract : Computational skill should be emphasized while strategically integrating the "Internet of Things" in education to prepare future workforce for the challenges ahead. Therefore, the curriculum content would have to be updated to develop students' understanding of the nature and advantages of Industrial Revolution 4.0 along with relevant modules to assist STEM education in the area of Information and Communications Technology (ICT). A major challenge to increasing exposure is the number of students taking Science, Technology, Engineering and Mathematics (STEM) subjects is declining annually. The popular reason of fewer students interested in STEM is because they tend to choose subjects that are much easier or they could not see how science can play a role in their lives. Thus, a game-based learning approach could facilitate in promoting STEM interest among students while inculcating the fundamental knowledge of ICT and its importance in daily life. ICT Society kit is developed with the objectives in tackling this issue. This kit comprises of two activities focusing on binary coding and logical thinking. A pilot study conducted in two rural schools in Kuala Selangor, totaling 47 participants, demonstrated this kit resulted in the participants gaining STEM skills including critical thinking, innovativeness, problem-solving, and decision making. There is a lack of Malaysian ICT STEM kits which can be conducted offline without the need of computer. This ICT Society kit is unique, mobile, affordable and most importantly, easily applied in a rural school setting. ICT Society kit offers great potential for commercialization and upscaling the production of this kit will allow outreach towards a larger crowd. This kit could inspire younger generations to pursue STEM fields, which is important to create a smarter and innovative society.

Keywords: STEM education, ICT Society, STEM Kit, Computational skill

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1. Introduction

The process of increasing student exposure to computational thinking skill in pre, primary and secondary school level is complex, requiring systemic change, teacher engagement, and development of significant resources. The future of education emphasizes the immense need of this skill and strategically utilizes the "Internet of Things" to prepare the coming workforce for the challenges ahead. Even alarming when recent study suggested that Malaysia is well-behind in term of digital literacy among ASEAN countries (Kusumastuti and Nuryani, 2020). Certainly, the curriculum content would have to be updated to educate students on the nature and benefits of Industry Revolution 4.0 as well as relevant module to assist STEM education in this area of Information and Communications Technology (ICT). Previously, study has suggested the importance of STEM Education in building ICT competent community (Aguiar and Pereira, 2020).

A major challenge to increasing exposure is the number of students taking Science, Technology, Engineering and Mathematics (STEM) subjects is declining annually. The popular reason of fewer students interested in STEM is because they tend to choose subjects that are much easier or they could not see how science can play a role in their lives. Thus, an interactive, game-based learning approach could facilitate in promoting STEM interest among students while inculcating the fundamental knowledge of ICT and its importance in daily life. ICT Society kit is developed with the objectives in tackling this issue. The kit is designed for unplugged activities to suit the target audience of rural areas as an affordable and easily-implemented educational tool. Previous study reported the effectiveness of offline approach to teach fundamental digital literacy (Menon *et al*, 2020).

2. Materials and Methods

2.1 Materials

This kit, as illustrated in Figure 1, is packaged in a small box which is easy to carry around. It comprises two activities focusing on binary coding and logical thinking.

Figure 1. ICT Society STEM Kit

2.2 Methods

The first activity involves the use of two colors of beads, each represents the 1 and 0 in the binary code. Participants will create their self-tailored hand necklace based on the binary coding of their initials. Meanwhile, the second activities integrate the understanding of algorithm concept with logical thinking. Participants are required to compose the algorithm by using the different colored buttons, each assigned for specific direction (left, right, up, down) in order to lead their avatar to the finishing point while avoiding obstructions.

A pilot study was conducted in two rural schools in Kuala Selangor, SMK Rantau Panjang and SMK Tiram Jaya from Kuala Selangor, Selangor, Malaysia. 47 students were evaluated via survey to assess STEM skills gained after completing the activities in the ICT Society Kit: critical thinking, creativity, problem solving, and decision making.

Data was collected in a 2-parts survey. The first part was assessing STEM skills gained from the ICT module: (a) critical thinking, (b) creativity, (c) problem solving, and (d) decision making. The research data incorporated seven statements for each skill based on their experiences on completing the activities in the kit. The second part was focusing on three main point of interest: (a) interest on the activity, (b) IT knowledge gained from the activity, and (c) kit impact on STEM interest. Likert scale was used where respondent rates 1-5 with 5 being the positive end and 1 being the negative end.

3. Results and Discussion

3.1 Results

Result is tabulated as in Table 1 in the form of mean value and the percentage of highest score (5) frequency.

Table 1: Conducted survey among participants after completing the activities in the ICT Society STEM kit

Item	Mean, $\bar{x}$	Percentage of highest score (5) frequency, %
Part A: STEM Skills		
Critical Thinking	3.46	
Creativity	3.08	
Problem Solving	3.38	
Decision Making	3.55	
Part B: Point of Interest		
Interest on activity	4.44	75
IT Knowledge gained from the activity	4.02	53
Kit impact on STEM interest	4.23	64

As shown in **Table 1,** the usage of this kit resulted in the participants gaining STEM skills including critical thinking, innovativeness, problem-solving, and decision making. Survey revealed favourable attitude towards the module with mean value above average: critical thinking (3.46), creativity (3.08), problem solving (3.38), and decision making (3.55).

3.2 Discussions

These findings indicate the effectiveness of this kit to promote STEM skills, essential in promoting digital literacy. The first activity is crafted to instill creativity and critical thinking by using the binary digits 0 and 1 to represent a letter to spell their name while making the hand-necklace. On top of that, the second activities bring video games to the basic by using coloured buttons as coding to move playable character to the finish line with shortest route. Strategy and logical thinking are essential to pass the obstacles on the board. Furthermore, the level of complexity is increases in the form of colour coding. This activity integrates the rules of algorithm by arranging the specific buttons in sequential order.

The module is considered effective based on the mean value higher than 4 for all of the questions in part B with students strongly agree that the module is interesting (75%) and increase their interest on STEM in general (64%). The hands-on activities from this kit which has the ethos of fun learning as its core could be one of the reasons that attract the participants. Previous study has reported the effectiveness of game-based learning approach in fostering computational thinking (Turchi *et al,* 2019). Similar positive feedback has been received in previous local studies with similar concept of modules and kits (Azman *et al,* 2021; Basar *et al,* 2021; Moid *et al,* 2021). avoiding obstructions.

Although 53% students find the module increase their IT knowledge, the average of students respond positively on basic IT gained from the module. This result suggested that this kit suits the targeted rural students which is consistent with previous study (Yuliana *et al,* 2020).

4. Conclusion

There is a lack of Malaysian ICT STEM kits which can be conducted offline without the need of computer. This ICT Society kit is unique, mobile, affordable and most importantly, easily applied in a rural school setting. The module of this kit has been demonstrated to several primary and secondary schools as well as STEM carnivals. The module received positive feedback from the public especially among parents and teachers, as they could see the interest of and knowledge gained by the participants while conducting the module as translated in the pilot study. The study received very positive feedbacks and based on observation and survey conducted, the participants were engaging and able to comprehend the fundamental knowledge instigated when using the ICT Society STEM Kit.

ICT Society kit offers great potential for commercialization and upscaling the production of this kit will allow outreach towards a larger crowd. This kit could inspire younger generations to pursue STEM fields, which is important to create a smarter and innovative society.

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