Adopting drone technology in STEM education for rural communities

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Abstract. The Science, Technology, Engineering, and Mathematics (STEM) subjects have always been the most challenging topics in education. One of the reasons is the dearth use of technology, especially for underprivileged students located in rural areas. Incorporating a drone in the STEM curriculum supports education that incorporates tangible experience such as observations, formation of concepts as well as creating imaginative and creative thinking. A drone@school initiative was introduced to foster the ICT technical and knowledge sharing among underprivileged students, hence exposing them to the recent technology in strengthening STEM education. The project has been carried out using an online platform by introducing the theoretical and application of drones in real-life practices. The responses from this project were very encouraging whereby utilizing drones as the medium, the level of understanding in STEM education had increased to 96.6%. Besides, the respondents' interest in STEM subjects significantly increased from 53.4% to 89.8%. The findings from the pre-and post-surveys revealed that the drone-based STEM learning approach had a positive impact on rural students' enthusiasm and excitement.

1. Introduction

STEM (Science, Technology, Engineering, and Mathematics) has become a widely known subject in modern learning studies in current days. Over these recent decades, there has been rising attention on STEM education, with demands for more attention on these subjects as well as enhancements in the effectiveness of teaching and learning. STEM education promotes a new style of teaching and learning that offers hands-on study and open-ended experimentation [1–4]. Students with a wide range of preferences, talents, and experiences can use this approach to develop abilities that will be useful in the 21st-century industry in creative problem solving, innovative thinking, cooperative teamwork, and computer skills. A drone has been acknowledged as an advantageous device for empowering STEM education due to its specialized design and ability to explore the exciting world from a bird's-eye view. The use of drone technology in education, on the other hand, is still in its infancy. Few studies elaborate on the use of drone technology in the teaching and learning process, and practically very scares that address to measure the enhancement of student interest and awareness in science using drones as a medium of communication. This paper reports a study on embracing drone technology in STEM education for rural communities focusing the rural primary school students.

2. Materials and Methods

A drone@school initiative was introduced to foster the Information and Communication Technologies (ICT) technical and knowledge sharing among rural and underprivileged students in Kelantan. For this, DJI Tello for Education drone was used to expose them to the recent technology in STEM education in strengthening science and mathematics subjects. The DroneBlock™ software was also used to support the programming session. Due to the pandemic Covid-19 restrictions, a series of programs were carried out using the online platform. This project was run in two phases, outlined as below:

First phase: A module on the technical and utilization of drones was designed and customized for primary school children level. This module has five topics including an introduction of drones, setting up the machine, utilization and technical part, coding, and analysis of data captured from the drones. The potential schools from rural areas were identified to carry out the module implementation. Subsequently, pre-assessment surveys on awareness and perception of rural students on ICT were carried out first before starting the module implementation workshop.

Second phase: The module was implemented to the primary school children at selected schools in an interactive way to deliver the knowledge. Post-assessment surveys on awareness and perception of rural students on ICT after joining the program were assessed. The quantitative data gained from pre and post-assessment surveys were analyzed to assess the achievement of the module implementation. The development of the module and instrument for the survey was developed based enhancement of several methods from previous studies by [5–11].

3. Results

A total of 118 respondents have participated in this project with ages ranging from 7 to 12 years old. 52.5% were male participants. According to a previous study by [12], male students benefited more from STEM education than female students in the process of learning and understanding ideas. However, research by [13] stated that there is no relationship between learning and gender. The awareness and perception of rural students on STEM subjects were assessed before and after the program using different parameters. It includes their interest and appreciation of STEM education as well as the usage and benefits of drone technologies in real life.

From the pre-and post-survey, we assessed that major of the participants know about STEM education. Before the program, 92.4% of participants can define and express the meaning of STEM and the application of these subjects at their schools (Figure 1). After the program, a slight increase of 4.2% from the previous data showed that the participants who become more exposed could recognize the gist of science and technology using the developed module. This is a remarkable outcome as we can evaluate that the respondents who came from rural primary schools disclosed their respectable understanding of STEM education when opportunities are provided. However, the teaching approach must be creative and comprehensive to the students as it can improve their understanding and develop their soft skills in ICT. Hence, previous researchers agreed that STEM educators must implement pedagogical methods to support student learning in the future [7].

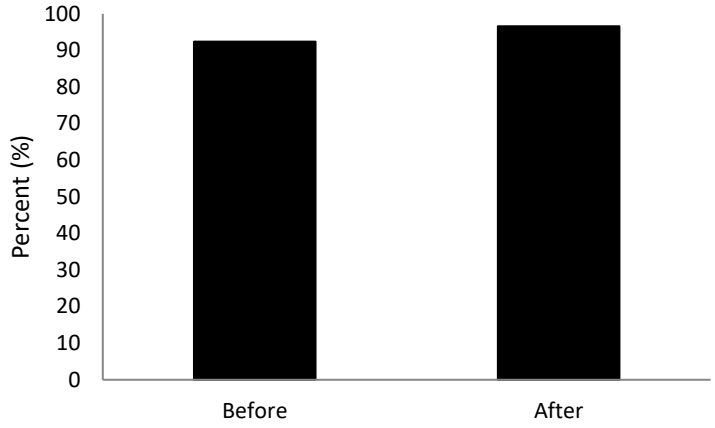

Figure 1. The participant's level of understanding in STEM education before and after the program

Of the total participants, only 54.3% expressed their interest in learning STEM courses at the beginning of the program (Figure 2). The remaining is more attentive in music and languages subjects. Surprisingly, after joining the program, the percentage significantly increased to 89.8%. This result indicates that the customized drone module had changed their perception of the difficulties to understanding the fundamental of STEM subjects and their implementation in real life. Our findings are in accord with a recent study indicating that over 25% of school students had inspiring and engaging moments with science and technology education by non-classroom teaching approach [7]. Furthermore, the STEM subjects can be more interesting to the students, especially in a rural area when the methods of teaching and learning are applied in creative approaches such as utilizing drones.

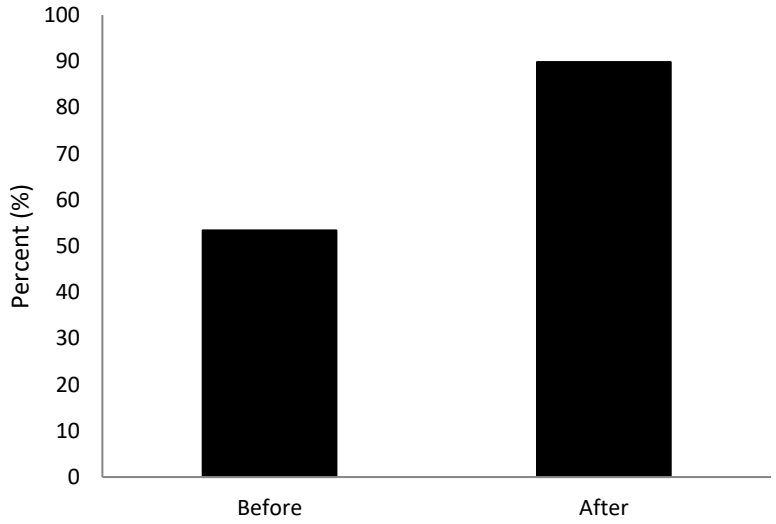

Figure 2. The increment of participant's interest towards STEM subject using drone module

Meanwhile, our survey showed an increased level of awareness and perception of the use of drone technology. Even the 81.4% of the participants had prior knowledge of drones and related technology, there are still a few others living in rural areas who have less or no exposure to this kind

of technology. After the program, 98.3% of the participants showed a greater perception of drones technology and its practical use in real life (Figure 3). These results indicate that the module implementation in the current study helped the respondents to fully understand the practical side of drones technology embedded in their science and mathematics subjects. These results agree with the findings of other research, in which the workshops on drones could help students to understand, construct, and interpret the knowledge related to STEM learning [8].

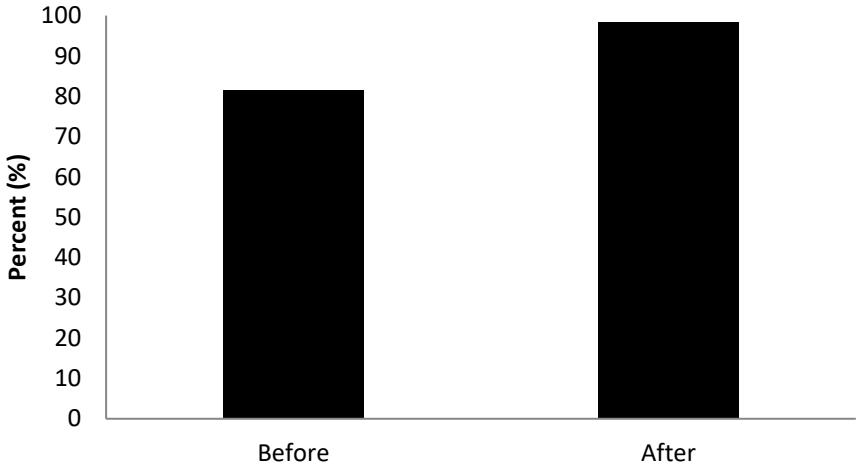

Figure 3. The participant's level of knowledge and perception of drones' technology before and after the program

Part of our training lessons requires students to utilize a computer algorithm to control and fly the drone in a specific path. This is the most exciting session for participants in the development of programming skills. They could try various algorithms taught in the workshop and develop drone coding as well as flying the drone on their own and customized instructions.

4. Conclusion

The Drone@school project has shown its capabilities in adopting technologies in bridging STEM education for the focal group of rural communities in Kelantan. The interest in STEM subjects increased significantly from 53.4% to 89.8% after the project implementation using developed and customized modules by the project team. The understanding level of drone technology also increased using non-classroom approaches by drone technology and its applicability in science and mathematics subjects is evident. Learning programming language or drone coding throughout the module teaching sessions has increased participants' enthusiasm in recent science and technology-driven tools. The content of drone modules for STEM enhancement is simple to understand and exciting, therefore it may also be used by instructors and students from different schools in strengthening STEM education, especially in rural areas and underprivileged communities.

Acknowledgement

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