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EXPLORING EDUCATION IN THE DIGITAL AGE: INNOVATIONS, INTERSECTIONS AND INSIGHTS

PREFACE

Dear esteemed readers and contributors,

It is with great pleasure and excitement that I extend a warm welcome to you all to this special edition of our journal, dedicated to exploring the diverse and dynamic themes shaping the landscape of education in the digital era. As we embark on this journey of discovery, each theme serves as a guiding beacon, illuminating the innovative intersections of technology and pedagogy.

Our first theme, Teaching based on Artificial Intelligence (AI), Machine Learning (ML), and the Internet of Things (IoT), sets the stage for our exploration by delving into the transformative potential of intelligent technologies in education. From personalized learning experiences to predictive analytics, AI, ML, and IoT hold the promise of revolutionizing traditional teaching methods and unlocking new pathways to knowledge acquisition.

Theme 2 invites us to immerse ourselves in the realm of 360 Learning, Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). Here, we witness the fusion of physical and digital worlds, as learners embark on immersive journeys that transcend the confines of the traditional classroom. Through experiential learning and interactive simulations, VR, AR, and MR technologies redefine the boundaries of education, offering unprecedented opportunities for engagement and exploration.

In Theme 3, we explore the power of Collaborative Teaching, Global Learning, and innovative practices such as Gamification, Maker-Space, and Maker Lab initiatives. This theme underscores the importance of collaboration, cultural exchange, and hands-on experimentation in fostering creativity, critical thinking, and problem-solving skills among learners worldwide.

Theme 4 sheds light on the paradigm shift towards Open and Distance Learning (ODL), Self-Instructional Materials (SIM), and the utilization of Big Data Analytics in Learning. Here, we witness the democratization of education, as learners gain access to high-quality resources and personalized learning experiences irrespective of geographical constraints. Big Data analytics further enhance the educational landscape by providing insights into learner behavior and preferences, enabling educators to tailor instruction to individual needs.

In Theme 5, we explore the evolving role of Social Media Learning as a catalyst for knowledge dissemination, collaboration, and community building. From online forums to multimedia platforms, social media offers a dynamic space for peer-to-peer learning, digital literacy development, and the cultivation of virtual learning communities.

Theme 6 invites us to embrace Design Thinking for new Learning Delivery, emphasizing the importance of user- centered design principles in creating innovative and inclusive learning experiences. Through empathetic design, educators can reimagine learning environments that foster creativity, adaptability, and lifelong learning skills.

In Theme 7, we delve into Andragogy in technology-based learning, Instructional Design, and Best Practices in e-learning. This theme highlights the importance of learner-centered approaches, effective instructional design strategies, and the dissemination of evidence-based practices to optimize learning outcomes in the digital age.

Finally, Theme 8 explores the Development of e-learning systems, materials, and mobile technologies, including the emergence of MOOC-based mobile learning materials. Here, we witness the evolution of educational technologies, as mobile devices and online platforms redefine the boundaries of access and engagement in education.

As we navigate through these diverse themes, let us embrace the spirit of inquiry, collaboration, and innovation that defines our scholarly community. I extend my deepest gratitude to all the contributors who have enriched this journal with their insights and expertise. May this edition inspire new ideas, spark fruitful discussions, and contribute to the ongoing dialogue surrounding the future of education.

Thank you for your dedication and commitment to advancing the frontiers of knowledge in the field of education.

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Theme 7: Andragogy in technology-based learning/Technology in learning/Instructional design in learning/Best practices in e-learning

1. Challenges and Innovations: Adapting Practical Culinary and Foodservice Subjects for Distance Learning during COVID-19
2. Exploring Tertiary Education ESL Learners' Dependency on the Internet, Internet Sources, and Internet Source Reliability

Theme 8: Development of e-learning system/Development of e-learning materials/Development of mobile systems in Learning/Development of MOOC-based mobile learning materials

1. Student Acceptance with the Usage of Padlet in Guiding Research Statistics Analysis
2. MOOC Courses Development: Guidelines for GLAM MOOC

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Exploring the Potentials of Robotic Inclusive Education in Supporting Students with Disabilities

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ABSTRACT

Educational robotics integrates robotics with science, technology, engineering, and mathematics (STEM) in providing hands-on learning experiences using robots and related technologies. This work funded by UNESCO grants has been conducted during a 3-day program entitled "Empowering STEM-based Robotic Education in Special Needs Schools" at "Pusat Pendidikan Khas Integrasi (PPKI)" SMK Puncak Alam 3, Selangor. Thirty participants were from the ages of 13-15. 85.7% were male students and 14.3% were female students. Zoom: Bit Robot Car Kit for microbit was used during the program. Participants were placed in three groups and introduced to the main modules consisting of Maker Line Sensor and Servo & DC Motors. They were exposed to simplifying line following for beginners, which consists of Auto calibration, Line Detection LED indicator as well as Analog & Digital output signals. They also learned about motor control and creation movements as the final part of the program. Based on the findings, 93% of the participants only found out about the microbit application at the school, which is during the program itself. At the end of the program, the program achieved the conclusion that Education Robotics helps to create a synergetic learning environment for stimulating students' motivation and collaboration among group members.

Keywords: disabilities, education, inclusive, robotics, Zoom:Bit

INTRODUCTION

In current years, robots have made significant penetration into the educational sector. Education indeed encompasses broad applications for robotics, a field that began to gain traction significantly through the work of Seymour Papert in 1980. His contributions, particularly with the development of the Logo programming language and the concept of constructionism, laid crucial groundwork for integrating robotics into educational settings. Robotics in education not only enhances students' understanding of STEM subjects but also fosters critical thinking, problem-solving skills as well as creativity via hands-on learning experiences. The initial role that robots can fulfill in educational environments is as a project for programming. Programming physical robots contextualize coding issues within the real world, enhancing engagement by allowing these skills to interact directly with one's environment (Beer et al., 1999; Billard, 2003; Coppin, 2002).

The second function of educational robotics is to serve as the central subject of learning, where the design and utilization of a physical robot are pursued as primary objectives. The primary objective is centred around hands-on experience such as designing, building, programming, and utilizing robots. This approach also boosted overall interest in science, technology as well as engineering. Classes that focus on application and incorporate project-based learning often benefit students who thrive in hands-on, integrative educational environments. These courses have shown long-term benefits, enhancing skills in teamwork, problem-solving as well as aligning students with careers in technology (Siegwart & Nourbakhsh, 2004). Dautenhahn and Werry (2004) developed a robot as a therapeutic tool for autism therapy. The robot was used as a therapeutic playmate, social mediator, and a model social agent. Reshaping learning environments, curriculum development, teaching practices, and student engagement via computer technology also addresses the opportunities and challenges presented by digital tools in education, emphasizing the importance of preparing students for the digital age (Balanskat & Engelhardt, 2015).

Robotics has been an emerging technology in cultivating STEM among school students in Malaysia. It is one of the support tools that allows interdisciplinary work in exploring the subjects, injecting curiosity, and performing experiments through playful activities and interactive learning (Balanskat & Engelhardt, 2015; Benitti & Spolaôr, 2017; Daniela & Strods, 2018; Anwar et al., 2019). In learning robotics, the integration of STEM has a vital role in promoting a comprehensive understanding. STEM education provides foundational knowledge and skills for students, such as mathematics concepts and the principles of physics (Chandra et al., 2020).

The recent trend in promoting robotics in STEM education among school students has positively improved learning motivation and improved self-learning. However, the exposure to robotic education among students with learning and physical disabilities is still low. Apart from the fortunate school community in the urban area and private/international schools, the exposure to robotics and STEM is mostly empowered to the B40 community and schools in the rural areas. Many outreach programs were targeted at underprivileged students. Most of the time, children with learning and physical disabilities are often forgotten. This resulted in students having learning and physical disabilities being left behind in technological proficiency and made it difficult for them to stay competitive in the current job market and other opportunities.

Among the limitations that led this group not to get the same benefits as the normal students are the lack of opportunities to access the platform and the shortage of qualified teachers and trainers in this field for learning and physical disabilities students. Furthermore, the available embedded education kit must be altered coherently to address the specific requirements of these special students. While the opportunities in cultivating robotics in STEM are tremendously exhilarating, there is a concern that these special students will become more marginalized if equal education policies and programs are not proactively planned and executed in learning and physical disabilities education.

Therefore, to address these gaps, the volunteering system among university students having learning and physical disabilities to become mentors for the students having learning and physical disabilities in delivering robotic education comes in handy. With their ability to understand these special students more, the process of transferring STEM knowledge becomes more feasible. Furthermore, it encourages students with learning and physical disabilities to be more confident and braver when embarking on technological-based education with the assistance of their special mentors, which aligns with the National Education Policy's goal of providing educational opportunities to all Malaysians, including the disabled. The potential of the learning and physical disabilities students in robotic STEM education can flourish if they are given the right approach.

METHODOLOGY

This program is to expose disabled students to STEM subjects based on robotic technology. PPKI SMK Puncak Alam 3, Kuala Selangor, has been selected. A total of 39 PPKI Students consisting of Form 1 and Form 2 students and 6 teachers have participated in this 3-day program, which starts from the 18th to 20th of October 2022. This program has been assisted by five (5) UiTM facilitators consisting of students with various types of disability. The selection of this facilitator is intended to increase the confidence of PPKI students who participate in this program because they can see good examples and the success that these disability facilitators have experienced. In addition, it can also provide a good opportunity for these disabled students to appear more enthusiastic, highlight their potential, and be more confident in dealing with the surrounding community.

To realize this program, three phases need to be done. The **first phase** is to identify the potential special needs UiTM student to be a mentor, followed by purchasing robotic educational kits (rero-microbit) from Cytron Technologies Sdn. Bhd. A training of trainer (ToT) program for special needs mentors was conducted by UiTM alumni from Cytron Technologies Sdn. Bhd. for three consecutive days. This marks the **second phase** of the program. This phase is conducted by UiTM. In the **third phase**, the mentors who have undergone the ToT training teach the teachers and students with learning or physical disabilities from the special needs schools, also for three consecutive days.

To cultivate STEM for the special needs students, a thorough tentative program has been arranged. The training will be conducted via an online platform on the first day of the training to familiarize participants with Tinkercad software. On the second day of training, mentors are assigned to assist special needs students in their schools. By anticipating the challenges of teaching special needs students, the hands-on session was conducted longer than simulation training. The creativity of disability/special needs students is believed to be enhanced by the psychomotor activity with the robotic training session. Thus, this program is significant to bring those in the special needs category to be excellent in the current stream of STEM path.

In this program, Zoom:Bit Robot Car Kit is used. This robot was chosen based on its attractive and colorful appearance of the robot to attract the interest of disability students as well as the complete functions of the robot on this device, which is suitable for learning purposes. The Zoom:Bit is programmed using open-sourced Microsoft MakeCode Editor. Through this program, a total of 8 hardware application modules as well as Zoom:Bit robot software (Figure 1) have been given.

Figure 1. Zoom:Bit Robot Car Kit

The modules that have been taught involve the application of Micro:BIT microcontroller identification, the use of sensors such as ultrasonic and reflective-type infrared, and the application of avoiding obstacles and following a path.

CLASS ACTIVITIES WITH ZOOM:BIT ROBOT CAR KIT OUTCOMES

This section discusses the survey done during the class activity using Zoom:Bit Robot. Zoom:Bit Robot Car Kit comes with a step-by step building guide written in simple language and graphics to help young learners to easily follow the instructions written.

Figure 2. Hands-On Session

The following are the results of the survey that has been conducted. A total of 14 PPKI students were selected as the sample size based on their level of reading skills and the level of skill in interpreting the questions given to them.

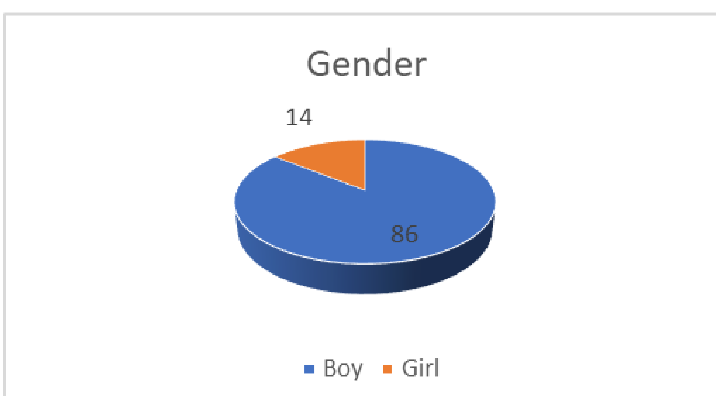

Figure 3. Percentage of Sample based on Gender

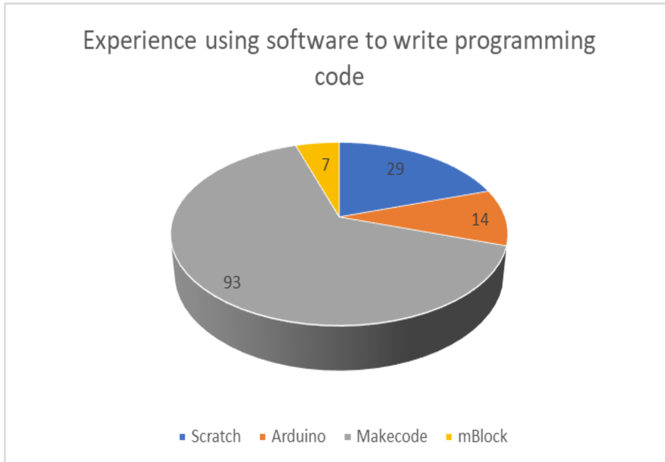

Figure 4. Experience Using Software

Figure 3 and Figure 4 is the survey done before the program. 14% of the samples are girls and 86% are boys. Based on the findings, 93% of the students have experienced using Scratch software, 29% with MakeCode, 14% experienced using Arduino, and 7% with mBlock software. The higher percentage of using Scratch software indicates that this free, block-based visual programming software is widely used for teaching programming concepts through visual and interactive interfaces with the aim of boosting children's programming skills (Kalelioğlu & Gülbahar, 2014). Meanwhile, MakeCode is gaining popularity as a platform for programming microcontrollers and creating interactive projects, especially in educational settings. However, the limitations of MakeCode compared to Scratch are the limitations in terms of what can be created (Xu & Liu, 2023).

The robot line following is a module that has a higher level of difficulty compared to other modules that have been taught to PPKI students. They have to combine all the modules learned in day 1 and 2. The difficulty of this module increases when there are many functions from other modules. They have to combine all modules to ensure that their line-following robots can operate well. Therefore, PPKI students who have higher concentration power are seen to be able to solve this problem quickly compared to others. In contrast, those with moderate and low levels of cognitive skills need to be assisted by available facilitators and lecturers (coaches) who attended the program.

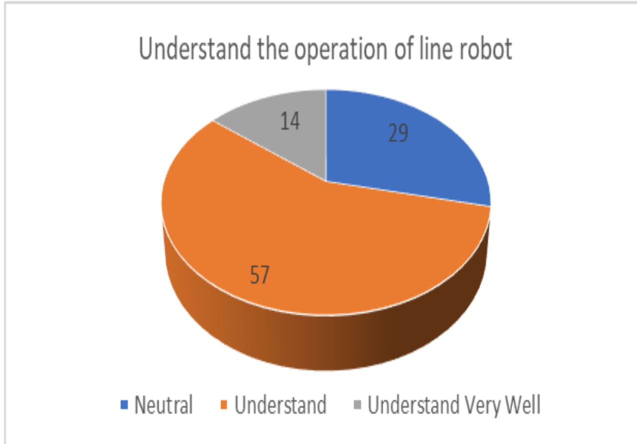

Figure 5. Students understanding of the operation

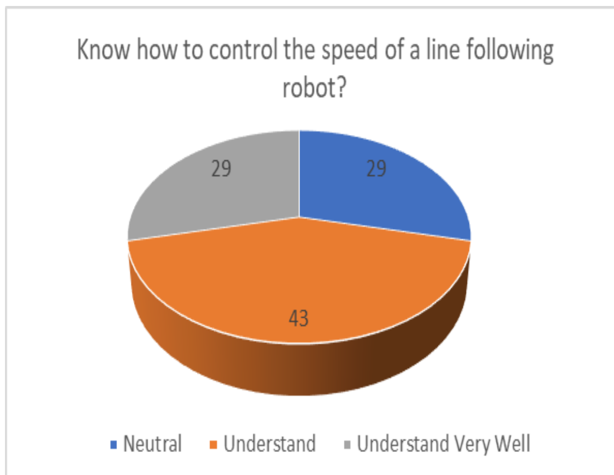

Figure 6. Students' capability to control

Figures 5 and 6 represent the student's understanding of the operation and their capability to control the speed of the robot based on the programming learned, with 86% understanding very well the operation of the line robot and 72% knowing how to program to control its speed.

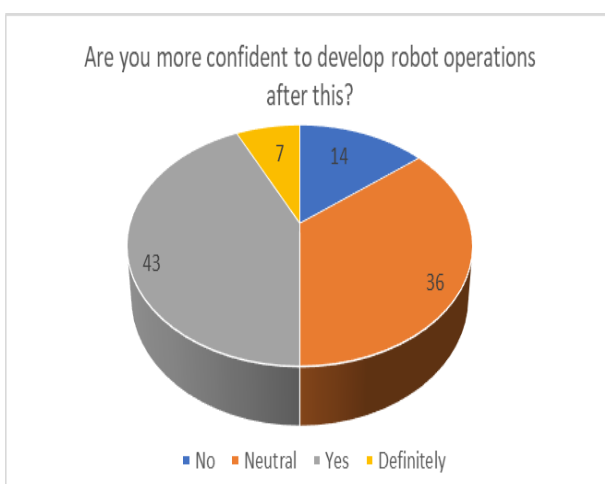

Figure 7. Confidence level

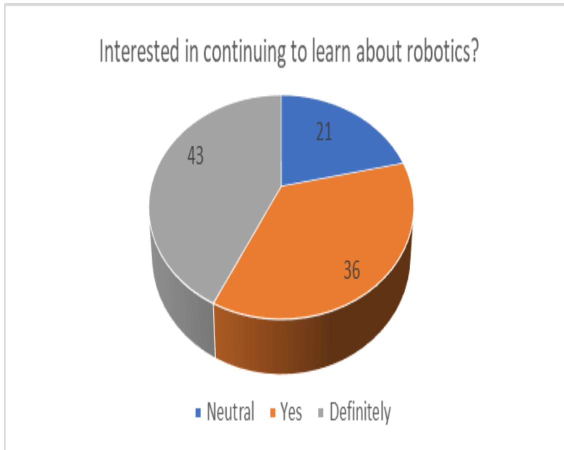

Figure 8. Interest in continuing to learn robotic

After the Day 3 program, Figures 7 and 8 illustrate that 79% of the disabled students have reported increased confidence in developing robot operations and expressed a keen interest in continuing to expand their knowledge of robotics.

CONCLUSION

From the program, the data highlights the positive impact of the program on students' confidence levels and proves the program's effectiveness in engaging students with disabilities in STEM education, particularly robotics. This is an indicator of a very good development in fostering PPKI students' interest in STEM subjects for their career development in the future.

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Conflict of Interest

We certify that the article is the authors' and co-authors' original work. The article has yet to receive prior publication and is not under consideration for publication elsewhere.

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Authors' Contribution

The authors declare no conflict of interest for this article. All authors participated in field work, conducted the literature review, and oversaw the writing of the entire article.

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