ENHANCING PROBLEM SOLVING SKILLS THROUGH MULTILITERACIES PROJECT APPROACH IN LEARNING ROBOTICS AMONG PRIMARY SCHOOL STUDENTS

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DEDICATION

This thesis is dedicated to my parents who have supported me throughout my studies that had enabled me to take this bold step in undertaking this arduous journey.

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ABSTRACT

In the Malaysian Education Blueprint, one of the students' aspirations is to develop students' critical thinking. However, based on the results in the TIMMS and PISA assessment, students have not fully developed this set of skills yet. In addition, students have not fully mastered problem solving skills skills which is vital as it affects employability in the era of the Industrial Revolution 4.0. In this study, 20 level two primary school students in Skudai were selected to participate in this study. They had to undergo as module tailored for this study known as Robotics Project Module. The module consists of 13 sessions including teaching and learning on robotics and programming, completing the tasks given and also a reflection session. Prior to the module, students were administered with a pre-test questionnaire modified from the Problem Solving Rating Scale Employees (PSRS-S) by Lohman (2004) which is a self-assessment and a rater-based assessment to measure problem solving skills among students. Upon completion of the module, pupils were again administered with the same questionnaire as part of post-test. Furthermore, an interview session was also conducted to acquire more information regarding the effects, strength and weaknesses of RPM. The questionnaire was analysed using a paired sample t-test while the interview was analysed using thematic analysis. Through this study, it is evident that RPM do help to enhance students' problem solving skills in terms of identify the issue, setting goals, generating solutions, making decisions, applying the solution and reflecting. In addition, the module also helped to develop two other skills namely collaborative and communication skills which is part of the aspirations of the Ministry of education Malaysia in developing and preparing students for the real world.

ABSTRAK

Dalam Pelan Pembangunan Pendidikan Malaysia, salah satu aspirasi murid adakah untuk melahirkan murid yang mempunyai kemahiran berfikir aras tinggi. Namun, berdasarkan penilaian TIMMS dan PISA, murid-murid masih belum menguasai kemahiran ini. Di samping itu, murid-murid masih belum menguasai kemahiran penyelesaian masalah yang penting untuk dunia pekerjaan dan era Revolusi Industri 4.0. 20 murid tahap dua dari sebuah sekolah rendah di Skudai telah dipilih untuk mengikuti kajian ini. Mereka akan mengikuti modul yang telah diubahsua untuk kajian ini iaitu Modul Projek Robotik. Modul ini terdiri daripada 13 sesi yang termasuk pengajaran dan pembelajaran robotik, pengaturcaraan, menyelesaikan tugasan serta sesi refleksi. Sebelum menjalani modul terebut, murid akan mengisi soal selidik pra-ujian yang diubah suai dari Problem Solving Rating Scale Employees (PSRS-S) oleh Lohman (2004) yang merupakan penilaian kendiri untuk mengukur kemahiran menyelesaikan masalah. Setelah menyelesaikan modul, murid-murid sekali lagi diberikan borang soal selidik yang sama dengan ujian pasca. Seterusnya, sesi temu ramah juga dilakukan untuk memperoleh lebih banyak maklumat mengenai kesan, kekuatan dan kelemahan RPM. Soal selidik dianalisis menggunakan ujian t-paired samples manakala temu bual dianalisis menggunakan analisis tematik. Melalui kajian ini, terbukti bahawa RPM membantu meningkatkan kemahiran menyelesaikan masalah pelajar dari segi mengenal pasti masalah, menetapkan matlamat, menjana penyelesaian, membuat keputusan, menerapkan penyelesaian dan refleksi. Di samping itu, modul ini juga membantu mengembangkan dua kemahiran lain iaitu kemahiran berkolaborasi dan berkomunikasi yang merupakan sebahagian daripada aspirasi Kementerian Pendidikan Malaysia dalam membangun dan mempersiapkan murid untuk dunia nyata.

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RPM	-	Robotics Project Module
MPA	-	Multiliteracies Project Approach

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In today's context, 21st Century Skills are increasingly important in this era of globalization and the Industrial Revolution 4.0. 21st Century Skills are essential especially in the working world thus becoming one of the main criteria in terms of employability. The lacked of 21st Century Skills could affect employability. This is due to a lack of employability skills among graduates. Over the years, employability has become a challenge as students lacked 21st century skills which are vital in the working world.

This is evident in terms of the increasing number of unemployability in the country. For instance, Ooi (2016) reveals in The Star Online that up to 161,000 (8.8%) of graduates aged between 20 and 24 are projected to be jobless in Malaysia in 2016. Other evidence also showed that the number of unemployment had gradually increased. Based on a report by the Malaysian Industrial Development Finance Berhad (MIDF) in 2018 as quoted in Puteh-Behak et. al. (2019) that Malaysian graduates unemployment rate has increased by 9.6% (204,000 graduates). These facts are alarming and the cause of this issue needs to be discovered and rectify.

Hairuszila, Hazadiah & Normah (2009) state past studies pointed lacked of employability skills could be the root of unemployment. Puteh-Behak et. al. (2019) defines employability skills as skills and knowledge that graduates need to acquire in meeting the needs of the working world. In addition, Suarta, Suwintana, Sudhana and Hariyanti (2017) further defines employability skills as graduates who possess a set of essential skills needed in the workplace which involve thinking critically, solving problems, making decisions, communication, analyse as well as working together as a team. The set of employability skills mentioned are parallel to the attributes of 21st

century skills. However, in this paper, problem solving skills will be focused as it is important in dealing with Higher Order Thinking Skills (HOTS) questions.

This eventually points to the lacked of 21st century skills and there is a need to discover a pedagogical approach which could enhance these skills. Therefore, 21st Century Skills should be inculcated and nurtured at a young age particularly in the primary education. Therefore, problem solving skills should be developed among students particularly beginning from the primary school education where they are acquiring basic and necessary skills for their social and cognitive development (Shin and Lee, 2008).

In the context of Malaysian education, the Ministry of Education had introduced the Malaysia Education Blueprint 2013-2025 (PPPM 2013-2025) which highlighted the 6 aspirations namely; leadership, dual language ability, ethics and spiritual, social identity, knowledge and thinking skills. These skills are essential to equip students with the necessary skills to compete at the global stage. Among the six aspirations, mastering thinking skills is considered the most important as it plays an important role in developing students to be more creative and innovative.

Nevertheless, thinking skills is no longer new as it was first introduced in the pedagogical aspect in schools nationwide through a program known as Critical and Creative Thinking Skills (KBKK) back in 1997. After 17 years of its implementation, it was revamped and further improvised which result in the implementation of the Higher Order Thinking Skills (HOTS) or also known as KBAT in 2014 by the Curriculum Development Department (BPK). This is parallel to the aspirations of the Malaysia Education Blueprint 2013-2025 (PPPM 2013-2025) which put great emphasis on ability to solve problems, decision making and innovation.

Countless efforts were made to ensure that critical thinking and problem solving are taught to students through lessons, teaching materials, programs, assessments, extra-curricular activities including projects. Among some of the projects that required problem solving skills involved robotics. In the age of The Fourth Industrial Revolution (IR 4.0), robotics has played an important role in education.

Robotics has become motivational instrument for students in the teaching–learning practice as it enables them to work in a holistic manner as well as developing several essential skills.

Robotics is based on two important elements namely; designing that involves innovation and programming which involves coding. These two elements are parallel to problem solving skills as they are needed to accomplish a task or solution. When students learn how to program, it influences the improvement of problem-solving skills, and therefore personal autonomy, based on the constructivist approach, in which the student is the main actor in the learning process (Kim et. al., 2015). Therefore, educational robotics should be further explored and developed to unleash students' problem solving skills which could help them in acquiring problem solving skills in preparing them for the future.

1.2 Problem Background

21st Century Skills are vital in preparing our learners for the real world faced with the challenges of globalization and the rapid changes of technology and work demand as well. Fisch & McLeod (2009) emphasised that in the future, students will not just face the changes in the kinds of occupations required but needed to be prepared for jobs which have not been created yet. This calls for the need in changing the curriculum in order for students to develop skills that could assist and prepare them for the future needs in workplace and occupation (Anderson, 2008).

Csapo & Funke (2017) emphasised that students' knowledge and skills will be obsolete by the time they have to use them in the working world if educators only prepare the students for existing prospects only. Therefore, students need to gain more knowledge about different subject areas and acquire crucial skills to ensure that they are prepared in the fast-moving world (Md., 2019). Along with the technological advancement, innovations, increasing globalization, changing in the current labour demands, economic pressures and rapid changes in competition in today's society, the skills required in the students to contribute to the society and increase their readiness for society were redefined (Wilmarth, 2010).

With the lacked of 21st Century Learning Skills in students, educators must act swiftly and find ways to instil of 21st Century Learning Skills in students in preparing them for the real world. Students must be equipped with the necessary skills that are able to prepare them for the working world. The individual should possess high level skills such as analytical thinking, inter-personal skills and organization of knowledge (Velez, 2012).

In addressing the problem, efforts have been made particularly at the Ministry of Education level in line with the aspirations of the Malaysia Education Blueprint 2013-2025 (PPPM 2013-2025). With the introduction of the Higher Order Thinking Skills (HOTS) or KBAT in 2014 by the Curriculum Development Unit (BPK), great emphasis was stressed in terms of thinking skills particularly in problem solving and decision making. In developing the students holistically, co-curricular was not excluded from the HOTS implementation. It focuses on involving students in co-curricular activities by emphasizing on problem solving in projects or tasks. In addition, exposure and a variety of activities provide opportunities for students to try, explore and innovate in projects they are working on. This aspires to ensure that students are able to think out of the box and do something that has not been thought before. However, there is a need to explore the best method to enhance the effectiveness of critical thinking particularly in the area of problem solving.

Based on the issues pertaining to 21st Century Skills on problem solving skills, Multiliteracies Project Approach can be recognised as a tool or medium in addressing this issue. Multiliteracies Project Approach is an approach which combines Multiliteracies and project-based approach focusing on incorporating various skills that can be acquired by students through a project. Multiliteracies is seen as an extended part of a pedagogy which involves practical concept of knowledge processes (Puteh-Behak & Ismail, 2018) while Kalantzis & Cope (2012), highlights learning process as “knowledge producers” and teachers as designers of learning.

Therefore, a module that encompasses Multiliteracies Project Approach could be a soloution in promoting 21st Century Skills on problem solving skills. Based on a previous study by Puteh-Behak & Ismail (2018), it is discovered that MPA proves to

be an effective medium in encouraging students to acquire skills from experiences such as a project. Puteh-Behak & Ismail (2018) also highlight several important aspects ehich included new necessities of learnings in the 21st Century Learning skills as well as the 4th Industrial Revolution (IR 4.0). In conclusion, a study on how MPA which incorporates the use of technology can affect students' 21st Century Skills on problem solving skills should be further explored to comprehend its effectiveness.

1.3 Problem Statement

From 1999 to 2011, Malaysia's Trends in International Mathematics and Science Study (TIMSS) performance showed a declining trend which manifest that the students' ability is decreasing and unable to make conclusions, generalisations and problem solving. TIMSS is an international assessment based on the subject of Mathematics and Science curriculum throughout the world. It evaluates students in Year 4 and Form 2 along other features such as algebra and geometry, and cognitive skills, namely the thinking processes of knowing, applying, and reasoning (Abdullah et. al, 2014).

Table 1.1 Malaysia's TIMSS performance 1999 – 2011 (Malaysia Education Blueprint 2013-2025 (PPPM 2013-2025)

	TIMSS 1999	**TIMSS 2003**	**TIMSS 2007**	**TIMSS 2011**
Malaysia's position	16	10	20	26
Number of countries involved	38	45	49	45
Malaysia's average score (A)	**519**	**508**	**474**	**440**
TIMSS average scale (B)	500	500	500	500
Difference (A) − (B)	+19	+08	−26	−60

Reviewing the TIMSS performance is vital as TIMSS is an evaluation which focuses on measuring students' capabilities in problem solving. It demonstrates that Malaysian students have not yet mastered problem solving skills hence the declining in the TIMSS performance. Besides TIMSS, critical thinking and problem solving

skills also apply to the current challenges in the real world especially in this era of the Industry Revolution 4.0 (IR 4.0). Azmi, Kamin, Noordin and Nasir (2018), listed reasons of unemployment due to the graduates lacked of non-technical skills namely; leadership skills, communication skills, teamwork skills, problem solving skills, entrepreneurial skills, critical thinking and creative skills. While, Azmi, Kamin, Noordin and Nasir (2018) also emphasised non-technical skills are skills that are seek in employability particularly in the Industry Revolution 4.0 (IR 4.0). These are vital in creating students to be global players and able to compete in the international arena.

In addition to problem solving in the Malaysian education context, the School-Based Assessment (PBS) is also used to assess students' critical thinking and problem solving skills which are needed in mastering a subject. The aspiration is to enhance students' ability from just merely knowing or understanding to be able to apply knowledge in solving problems. The purpose is to ensure that students do not just memorise and do well in exams but possess the knowledge and the ability to apply what they have learnt to solve problems in the real world context.

Table 1.2 Malaysia's School-Based Assessment (PBS) Criteria

Mastery level	Interpretation
1	Know basic knowledge of mathematics.
2	Know and understand basic knowledge of mathematics.
3	Know and understand basic knowledge of mathematics to perform basic mathematical operation and basic conversion.
4	Know and understand the knowledge of mathematics to perform calculation steps in solving routine daily problems.
5	Master and apply the knowledge and skills of mathematics in solving routine daily problems using various strategies.
6	Master and apply the knowledge and skills of mathematics in solving **non-routine daily problems** creatively and innovatively.

Hence, 21st Century Skills are needed in addressing these issues. Critical thinking and problem solving skills is not only limited to the subjects of Science and Mathematics but in involves all subjects across the curriculum. However, it is challenging to impart 21st Century Learning skill set directly as the skills are not confined to a specific subject (Orpwood et al., 2012).

Teachers are required to comprehend the issue and to overcome it by preparing strategies and approaches that can be effective in enhancing students' critical thinking and problem solving skills. Malaysia's blueprint of its Tenth Malaysia Plan (2011-2015) is the national agenda to prepare students to compete in the global community. The Tenth Malaysia Plan focuses on "the aspirations of both the Government Transformation Programme and the New Economic Model, premised on high income, inclusiveness and sustainability (Ganapathy, 2014).

To address these issues, Multiliteracies Project Approach (MPA) could be the key in enhancing 21st Century Skills on problem solving skills. In doing so, MPA should be further analysed and studied on how it can affect problem solving skills among students in preparing them for the future. Therefore, this research serves to investigate on how Multiliteracies Project Approach (MPA) through robotics can serve to develop and further enhance students' 21st century skills particularly in problem solving which is important in the real world context.

1.4 Research Objectives

The research objectives are as follows;

1. To develop a module for Multiliteracies Project Approach through robotics to enhance problem solving skills.

2. To determine the effects of Multiliteracies Project Approach through Robotics on students' problem solving skill.

3. To determine on how Multiliteracies Project Approach through Robotics can enhance problem solving skill among primary school students.

1.5 Research Questions

The research questions are as follows;

1. What are the effects of Multiliteracies Project Approach through Robotics on students' problem solving skill?

2. How does Multiliteracies Project Approach through Robotics enhance problem solving skill among primary school students?

1.6 Variables

There are two variables in the study namely; independent variable and dependent variable. The independent variable would be the Multiliteracies Project Approach through robotics while the dependent variable would be the 21st century learning skills focusing on problem solving skills. The intervention or treatment of the

study is the robotics module. This study serves investigate on how Multiliteracies Project Approach through robotics can influence, effect or enhance primary school students' 21st Century Learning Skills focusing on problem solving skills. Diagram 1.1 demonstrates the relationship between the two variables.

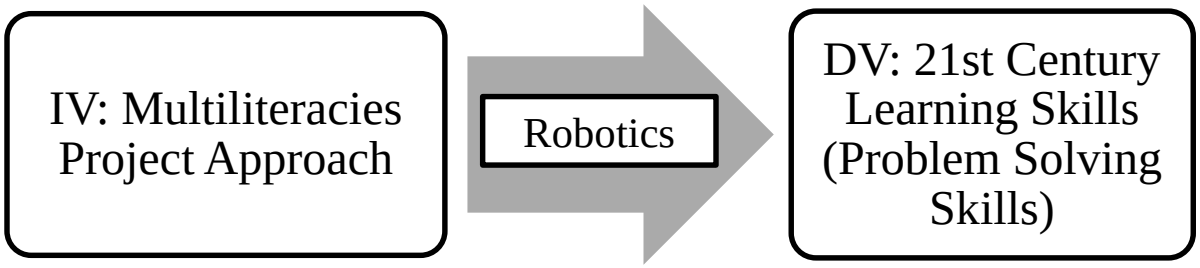

Figure 1.1 Variables Diagram

1.7 Conceptual Framework

Diagram 1.2 demonstrates the conceptual framework of this study. This conceptual framework serves to provide an overview of the study and to plan the research procedure and timeline.

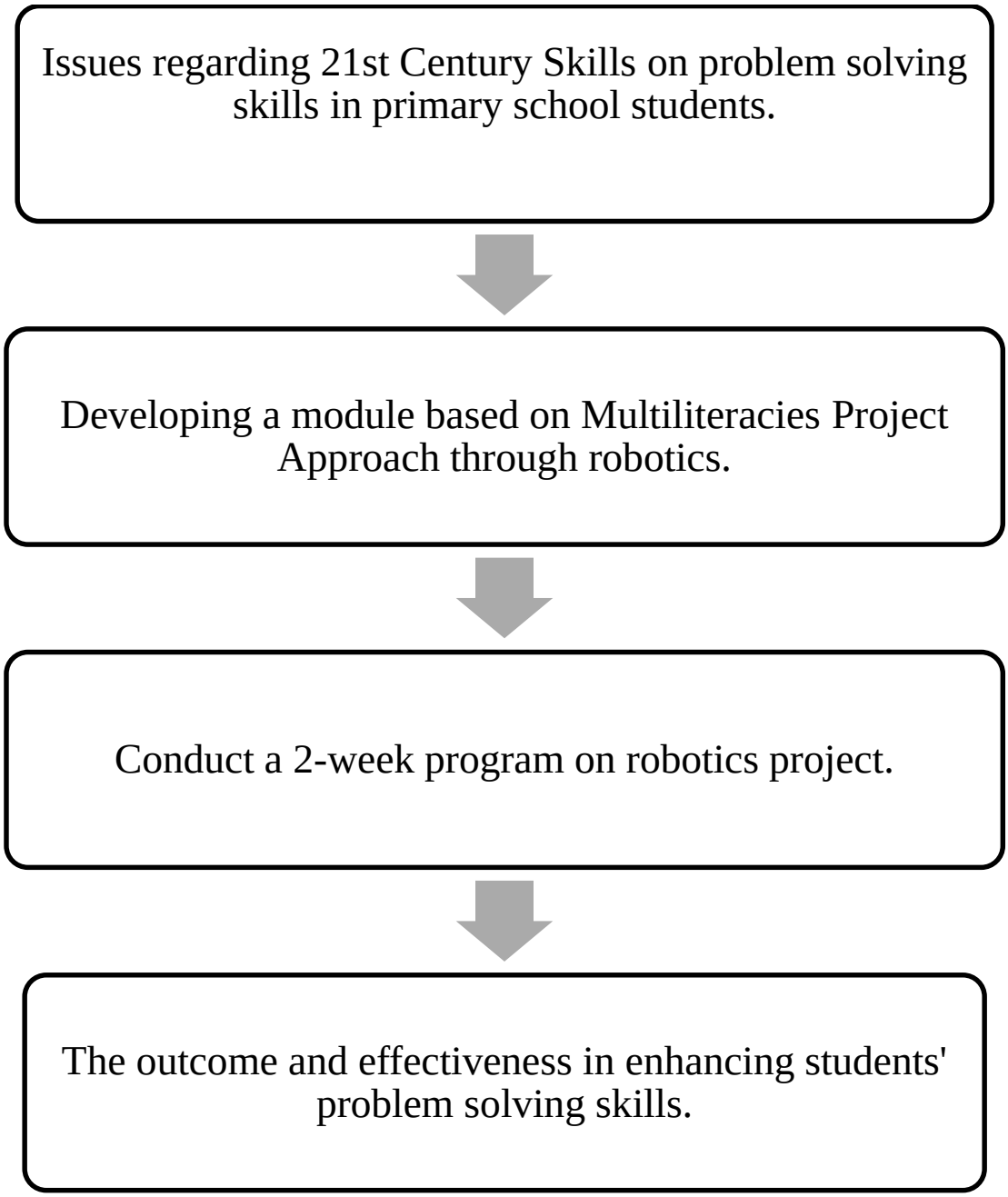

Figure 1.2 Conceptual Framework

1.8 Rationale of the Study

This research serves to investigate on how Multiliteracies Project Approach (MPA) can serve to develop 21st century skills among primary school students. In addition, this study will investigate on how MPA is used to enhance 21st century learning skills among primary students. This study would serve guide for primary school teachers in lesson planning to incorporate 21st century skills. According to

Gültekin (2007), primary school, which is the initial step of primary education, sustains the society by transferring the cultural background and values of the society to the future generations; on the other hand, by providing basic information and skills for the individuals, it increases the social and cultural level of the society.

1.9 Significance of the Study

In preparing our students for the real world, 21st Century Learning skills are important and must be instilled in the students. Therefore, the rational of this study is to investigate on whether Multiliteracies Project Approach can promote problem solving skills in primary school students. In addition, this paper would also highlight several aspects of 21st century skills such as knowledge to use current technologies for diverse purposes, critical thinking skills to identify, reflect, analyze and evaluate information presented by multimodal texts and the ability to work in teams and on peer-collaborative tasks. In addition, this paper helps to define the roles and helps to understand how robotics can be used to enhance problem solving skills which are vital in helping them to solve questions which involved higher order thinking skills (HOTS). It also helps teachers to understand the requirement needed to formulate method to teach students' problem solving. To sum up, this paper explores on how MPA is used to enhance and promote problem solving skills in students.

1.10 Research Scope and Limitation

This research is limited to the students of a primary school in Skudai and is confined to a singular school setting, therefore it cannot be generalised to other schools or students from other districts or states in Malaysia. However, the research could serve as a guide for other school in the Malaysian primary school context.

1.11 Operational Definition

1.11.1 21st Century Learning

21st Century Learning Skills is based on the P21 (Partnership for 21st Century skills) Framework. P21 is used to investigate the interactions between 21st Century skills and education and their instruction in core disciplines to identify and define 21st Century skills (P21, 2009). The skills in 21st Century Learning Skills play an important role in students' development to prepare them for the real world. The skills

should be acquired as early as during their primary education to ensure that they are ready and well prepared for the challenges ahead of them.

1.11.2 Problem Solving

Problem solving skills is a subset of critical thinking in the 21st Century Learning. Problem solving is used extensively and is a part of our daily lives. It is no longer confined to subjects like mathematics but is widely used across the curriculum particularly with the introduction of the Higher Order Thinking Skills (HOTS) or KBAT in 2014 by the Curriculum Development Unit (BPK), whereby great emphasis was stressed in terms of enhancing students' thinking skills particularly in problem solving and decision making.

1.11.3 Multiliteracies Project Approach (MPA)

Multiliteracies Project Approach is a combining of Multiliteracies and Project Based Approach. Puteh-Behak & Ismail (2018) emphasised that Multiliteracies Project Approach as a pedagogical approach utilising both Multiliteracies and Project Based Approach in encouraging students to acquire skills through project based experiences.

1.11.4 Educational Robotics

Educational robotics involves programming and simple coding in making the robot moves and to complete the task. It is no longer confined to the engineering field but has been widely utilised in the field of education particularly in certain subjects and extra-curricular activities. It comes in various platforms; however they are similar in terms of function and purpose. Types of robots such as Lego Mindstorms, Rero, Arduino, Microbit and many more promote the skills of critical thinking as well as problem solving skills. It is also used to spark innovation and creativity among students. In this study, Mechabotics and Tinkercode will be used as a tool for students to use when coding the robots.

1.12 Conclusion

In this chapter, background and issues are being discussed and presented as a basis for this study. Current issues were identified to formulate a basis for this study as well as developing a solution to the problem presented earlier. In addition, a further review of the literature will be conducted in the next chapter to further understand the issue, concepts, approaches and reviewing of past studies which could be helpful to the study and formulating the appropriate method.

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