

## BOOSTING TVET PROBLEM-SOLVING ABILITIES THROUGH THE IR4.0 FOR ALL WORKSHOP AMONG THE SCHOOL STUDENTS IN MELAKA

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**ABSTRACT:** In Malaysia, inadequacies in analytical and creative thinking skills stand out as the primary factor hindering 37,000 public university graduates from securing employment and advancing to professional roles. To overcome the issues, Politeknik Merlimau has organized The IR4.0 for All Workshop participated by 72 students from the primary and secondary schools around the state of Malacca from 24<sup>th</sup> to 25<sup>th</sup> June 2024. The approaches of this workshop are by TVET knowledge sharing related to programming, installation of electronic components, problem-solving skills and construction of IoT robots. Descriptive research was selected and a set of questionnaires was employed as the research instrument both before and after the program implementation. The respond was analysed using the Statistical Package for the Social Sciences (SPSS) version 25. Three aspects of the study are Training Material Efficiency, Workshop Execution Effectiveness, and Problem-Solving Skills Effectivity with reability scale,  $\alpha > 0.7$ . A total of 97% respondents highly agree that the training materials aiding the information. Finds show that the workshop has a strong potential for students to enhance their knowledge. Comparing their scores before and after the session, 40% and 60% of participants rated their confidence in their ability to solve problems at a level of 4 and 5, respectively. In conclusion, students in Melaka have shown an improvement in their ability to solve problems, particularly those involving technical abilities, as the hands-on and guided learning provided by the IR4.0 For All Workshop.

**KEYWORDS:** *Internet of Things, IR 4.0, Robotic Workshop, TVET*

### 1.0 INTRODUCTION

The Fourth Industrial Revolution will impact the entirety of human existence [1]. Higher education systems worldwide are also undergoing transformations due to the Fourth Industrial Revolution[2]. Institutions of higher learning must actively incorporate the IR4.0 into the courses they offer. Industry 4.0 is the process of combining artificial intelligence, data, robotics, and communication to build an intelligent and productive industrial environment[3]. The term "Internet of Things" (IoT) describes a network of real-world things, such as cars, appliances, and other machinery, that are integrated with software, sensors, and network connectivity to enable data collection and sharing[4].

The rapid growth of IR4.0 has led to the development of various innovations, including the capacity for creative and innovative thinking. According to, Isaksen, & Stead-Dorval[5], creativity is defined as the capacity to create, generate, and cultivate novel and innovative concepts. Creativity involves harnessing the power to create and utilize creative abilities. As per Rawlinson[6], creative thinking involves generating ideas, while critical thinking involves assessing those ideas. Buzan[7] highlighted schools as pivotal institutions for nurturing creativity in children, particularly within the preschool setting. Universities play a crucial role in fostering students' creative abilities. By promoting creative thinking, a generation adept at employing creative problem-solving skills can be nurtured.

A deficiency in problem-solving abilities among students contributes to academic underachievement. In Malaysia, inadequacies in analytical and creative thinking skills stand out as the primary factor hindering 37,000 public university graduates from securing employment and advancing to professional roles[8]. Given the rapid technological advancements, researchers must continuously explore novel concepts and alternatives to enhance the efficacy and efficiency of the educational process. Consequently, participants have limited exposure to diverse technologies in the realm of robotics. Hence, through the IR4.0 For All workshop, researchers can assess the efficacy of students' problem-solving skills.

Education 4.0 is essential for integrating high-impact technological advancements into education, incorporating cutting-edge methods like Cloud Computing. It is also important to highlight the concepts of the digital economy, artificial intelligence (AI), and big data. Robotics, space technology, and other fields[1]. A study by Fischer[9] indicates that heightened investment in robotics results in the advancement of artificial intelligence in robots. Nowadays, Gen-Z is a computerized generation with a unique comprehension and articulation attitude. They also possess digital capabilities and smart, intelligent intelligence. Additionally, they have the ability to use the Internet to their advantage and create innovative, creative, and expressive computational innovations[10].

The study's objective is to:

- i. assesses the efficacy of implementing the workshop through theoretical and practical testing assembly.
- ii. evaluate student achievement in problem-solving skills within the realm of programming and operating robots.

The inquiry ponders:

- i. Enhancing problem-solving skills in robot design and operation through Workshop implementation.
- ii. What is the effectiveness level of this workshop implementation?

Politeknik Merlimau has organized an IR4.0 for All Workshop participated by primary and secondary schools around the state of Melaka from 24 to 25 June 2024. The approaches of this workshop are by sharing knowledge related to programming, installation of electronic components, problem-solving skills and construction of IoT robots. One of the main components of the IR4.0 idea is IoT.

## **2.0 METHODOLOGY**

### **2.1 Research Methodology**

Descriptive research was selected to assess the efficacy of the workshop. IR4.0 For All focuses on the involvement of middle school and primary school students across Melaka. Research design constitutes the primary planning and strategy for addressing research inquiries conveyed through data collection and analysis methods[11]. A set of questionnaires was employed as the research instrument to assess the program's efficacy. The questionnaire was administered both before and after the program implementation. Data was gathered using a descriptive survey approach to evaluate the program's execution and impact on the participants.

### **2.2 Population and Sampling**

The study's population comprises all students who participated in the workshop, as selected by the researcher. According to Mohamad Najib[12], the descriptive survey method is ideal for elucidating the relationship between two variables. Question about perception using a 5-point Likert scale where the stages have been used starting with the values 1=Very Disagreeable (VD), 2=Disagreeably(D), 3=Not Certain (NC), 4=Agree(A) and 5=Surely Agree

(SA). The respondents' answers were analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.

A questionnaire was utilized as the instrument, distributed to gather feedback and information from respondents regarding the research question. Mohd Majid[13] asserts that questionnaires serve as a measuring tool in educational research, offering insights into facts, beliefs, feelings, and desires. Khalid[14] supports the common use of questionnaires as a data collection tool by researchers, enabling the gathering of detailed, structured, and standardized data. The significance of sample size, noting that smaller populations yield less accuracy[15]. Therefore, selecting the entire population as respondents is crucial to mitigate challenges arising from using a small sample and to ensure meaningful research outcomes.

### 2.3 Research Tool

A set of questionnaires distributed to respondents consisting of two. Part of the question is as follows:

#### Part A: Respondents' Demographics

This section contains an overview of gender and participants background in the IR4.0 field.

#### Part B: Program Effectiveness Level

This section comprises 10 questions regarding implementation components and program effectiveness.

### 2.4 Data analysis

Based on the work of Mohamed Najib in 1999, the study's objectives and research inquiries, along with the mean frequency distribution and percentage, can be determined by analysing key variables. This is assessed according to the average score level as presented in Table 1.

Table 1: Mean Interpretation

Mean Score	Mean Score percentage	Mean Score Level
1.0 – 1.49	20.0%-29.8%	Very Low
1.50 – 2.49	30.0%-49.8%	Low
2.50 – 3.49	50.0%-69.8%	Moderate
3.50 – 4.49	70.0%-89.8%	High
4.50 – 5.00	90.0%-100%	Very High

The value of the reliability scale,  $\alpha > 0.7$  is an indicator that indicates that the survey item is reliable and acceptable. In the questionnaires, as many as three aspects of the study are Training Material Efficiency, Workshop Execution Effectiveness, and Problem-Solving Skills Effectivity with each consisting of 3, 4 and 3 items. Table 2 shows the reliability assessment of this study.

Table 2: Assessment of the reliability of the construction of the survey item

Dimension	Total item	Alpha ( $\alpha$ )	Interpretation
Efficacy of Training Materials	3	0.949	Reliable
Efficacy of workshop execution	4	0.933	Reliable
Efficacy of problem-solving skills	3	0.922	Reliable

### 3.0 RESULTS AND DISCUSSION

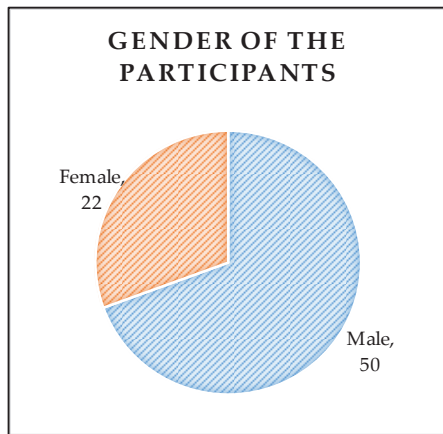


Figure 1

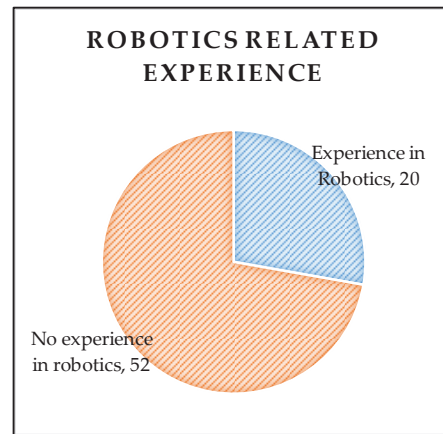


Figure 2

Figure 1: Gender of the participants  
 Figure 2: Robotics related experience

The analysis was conducted based on a questionnaire completed by 72 workshop participants. The results indicate that 71% of the respondents are male, and 29% are female, as illustrated in Figure 1. Figure 2 demonstrates that the smallest portion of respondents, 28%, or 20 students are students with background in robotics. The majority of respondents, 72%, have limited experience in the field of robotics.

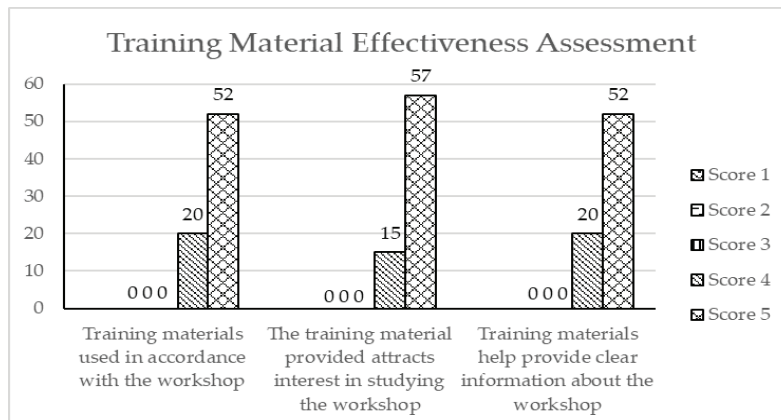


Figure 3: Efficacy of Training Materials

In reference to figure 3, the evaluation results of the training materials' effectiveness indicate that none of the respondents selected scores 1, 2, or 3 when using the course-aligned materials. Conversely, 20 individuals achieved a score of 4, accounting for 28%. The remaining 52 participants attained a score of 5, constituting 72% of the total. The average proportion of engaging training materials selected by respondents excludes scores 1, 2, and 3. 15 individuals opted for score 4, equivalent to 21%, whereas 57 individuals favoured score 5, amounting to 79%. Similarly, the average percentage of training materials aiding in conveying course information, with no selections for scores 1, 2, and 3. 2 respondents chose score 4, reflecting 3%, while 70 individuals selected score 5, representing 97%. Overall, all respondents thought the training materials such as notes and equipment were clear and adequate.

Figure 4 depicts an assessment of the IR4.0 workshop. The data reveals that the average score percentage is notably high, indicating a strong potential for students to enhance their knowledge. Specifically, 60 individuals, constituting 83%, rated the workshop with a score of 4, while 12 individuals, representing 17%, rated it with a score of 5. Among those who

believe they can enhance their skills, 65 students, accounting for 90%, selected a score of 4, whereas 7 students, making up 10%, opted for a score of 5. In terms of improving problem-solving abilities, 2 students, equivalent to 2%, favoured a score of 4, while 70 students, representing 98%, favoured a score of 5. Furthermore, 72 students, all of whom selected a score of 5, represent 100%, believe they can enhance their self-motivation skills. Overall, the workshop implementation has achieved its target where the program has helped improve the knowledge, TVET skills, problem-solving skills and self-motivation among the participants.



Figure 4: Efficacy of workshop execution

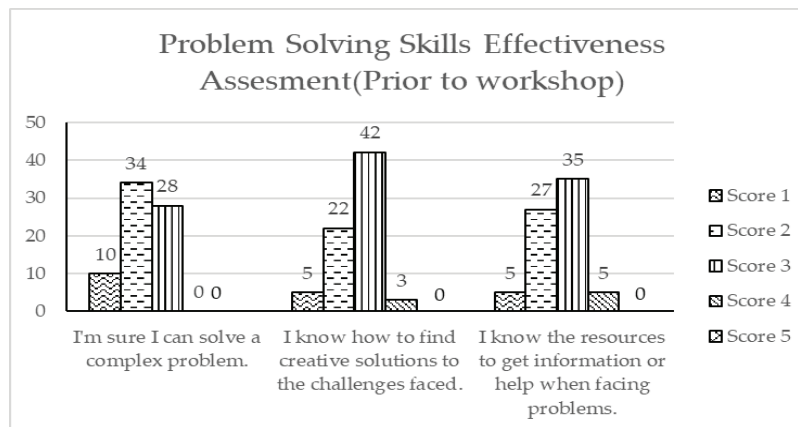


Figure 5: Percentage of Self-Assessment Mean Score Prior to Workshop

The self-assessment results prior to the workshop commencement are depicted in figure 5, illustrating the students' self-assessment regarding familiarity with the resources utilized for obtaining information or assistance when encountering challenges. 5 individuals selected a score of 1, constituting 7%. In contrast, 27 individuals opted for a score of 2, accounting for 37%. Subsequently, 35 individuals selected a score of 3, which is representative. 49%. The remaining 5 individuals selected a score of 4, amounting to 7%. To address the challenges effectively, 5 individuals were in the same score. 1 represents 7%, with a total of 22 individuals scoring 2, representing 31%. Next as many 42 individuals scored 3, accounting for 58%. The remaining 3 individuals scored 4, representing 4% in total. The information revealed that participants' problem-solving abilities were low before to enrolling in the workshop.

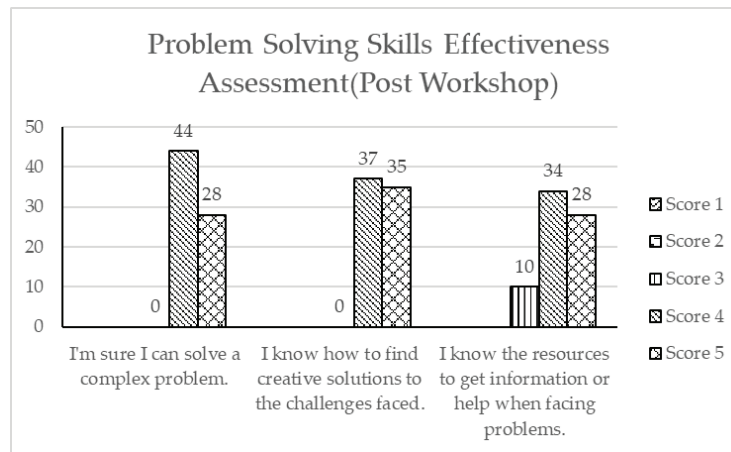


Figure 6: Self-Assessment Mean Score Percentage Post-Workshop

The graph illustrates at Figure 6 show the mean score percentage of participants engaging in the IR4.0 For All Workshop. It reveals that the mean score percentage is notably high, indicating that students are adept at accessing information or assistance when encountering challenges. Specifically, 10 individuals, constituting 14%, rated this aspect as 3. Additionally, 34 participants, representing 47%, rated it as 4. The remaining 28 individuals, accounting for 39%, rated it as 5.

The average proportion of students proficient in finding innovative solutions to challenges is notably high. A score of 4 is selected by 37 individuals, accounting for 51%, whereas 35 people opt for a score of 5, equivalent to 49%. The average proportion of students confident in solving complex problems is high, with 44 individuals scoring 4, equivalent to 61%, and 28 individuals scoring 5, equivalent to 39%. Data indicates that following the workshop, participants' problem-solving abilities have improved to the point that they are more assured of their ability to tackle challenging issues and are aware of the resources and techniques available to them.

#### 4.0 CONCLUSION

The conclusions obtained through a workshop that applied methods of design, installation, encoding and testing in theory and practice have demonstrated the effectiveness of this program with an increase in all mean scores. Based on the item in Problem solving skill Effectiveness Assessment before the workshop was conducted, there were 64 students who chose scores 1 to 3, which is 89%, but after the workshop there was a significant increase where only eight people picked scores from 1 to 3 equal to 11%. The students who chose scores 4 and 5 were 64 of them, which is 89%.

Hands-on and guided learning via IR4.0 For All Workshop has successfully helped improve problem-solving skills among students in Melaka especially problems involving technical skills. Consequently, it is recommended to advance the workshop to a more advanced stage to foster creativity and innovation among participants in robot design and problem-solving.

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