

# Mechanical Workshop Practice Acquainted Through Augmented Reality (AR)

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**Abstract** - Currently, the swift technological growth has led to technological evaluation that is in line with the existence of industrial revolution 4.0. The field of education is also not left behind in the current 4.0 industry development which directed to education 4.0. With the launching of Malaysia Education Development Plan 2015-2025 for higher education steps have been taken to push the Technical and Vocational Education and Training (TVET) which includes special intervention in teaching and learning in this field. Correspondingly, augmented reality being the interactive method of technology that has been hypnotize peoples especially generation Z. In this regard, 21st Century learning methods are subjected to the technology based in order to attract the student. Consequently, the researchers have made a study on augmented reality technology approach towards Mechanical Workshop practice 1 especially in welding workshop, machine workshop and fitting workshop among the Mechanical engineering students in Politeknik Tuanku Syed Sirajuddin, Arau, Malaysia in order to produce an innovation that can be impacted and interactive to the students. As a result, the innovation of Mechanical Workshop Practice Acquainted through Augmented Reality (AR) has been created. Pre and post-test has been conducted among the students who taking for Mechanical Workshop Practice 1 course in order to evaluate the effectiveness of the poster. This innovative product has wide opportunity to be marketed to all Polytechnics in Malaysia and all Malaysian institutes of higher education which have Mechanical Engineering department.

**Key Words:** Augmented Reality Technology, Mechanical Workshop Practice, Industrial revolution 4.0

## 1. INTRODUCTION

In this era of globalization, those who often use the internet and been labeled as "generation net" of "Generation Z" which means that those who use internet in the daily of their life. Although the using of internet is not fully utilized but, at least everybody has a smartphone. Therefore, the word "Digital Era" came from the situation that everyone is surfing the internet and known as the Digital Age [1]. The digital era has made it easy for us to use the high-tech gadgets that we often see and have used them since young age. For example, computers (desktops), laptops, tablets, smartphones and more. These gadgets have facilitated and safeguarded our personal affairs especially in the search of information, communication etc. According to [1] with the technology of

the gadgets, the wave of evolution "Industrial Revolution 4.0" or known as "Industry" 4.0 has begun.

Those who were born in the era of mobile computing, which known as Z generation, which is proficiently share the information through social media and interest in learning new things online [2]. However, students need to have the initiative to create a new learning experience for the Gen Z students. Then [2] listed three steps that can achieve that desire. First, understand the Gen-Z students and the way they learn. Secondly, redefine the conventional teaching concepts based on instructional content in preparing students for the future and lastly, improve the learning of the 21st century with the suitable of Gen-z's needs.

Nowadays, the learning styles should suitable with current needs. For example, the previous generation such as gen x and gen y, using the conventional way of learning. Nonetheless, Gen-z need the learning of the 21th century which more to technology usage. 21th century learning is easy way to study. The technology approach that can provide interesting way of learning especially, to welcoming and attract interest of new students especially in Polytechnic Malaysia.

Fundamentally, most of the student did not have basic knowledge especially in Mechanical Workshop Practice. Therefore, they need more time and medium that can attract their interest and enhance their understanding. Therefore, according to [2], AR is a suitable medium to use as a learning tools.

## 2. LITERATURE REVIEW

This section will discuss on several information and facts related to this paper. It begins with the generation Z, augmented reality, followed by industry 4.0, learning methods which is consists of conventional and 21st century learning methods.

### 2.1 Generation Z

The generation gap means there is a difference between one generation and another generation. The former generation and generation are different. Although there is a difference or gap between the characteristics of each generation, but it is not a barrier to achieve a common cohesion for success.

Successful organizations can combine ideas and views between generations among workers and employers [3]. However, who is the Z generation? According to [4], generation Z is a group that was born in 1998 to 2009. Generation Z is a technology generation that will preserve the country and the world in decades from now.

## 2.2 Augmented Reality

Utilization of Information Technology (IT) in the process of delivering information is experiencing rapid development. Currently, the latest technology used in delivering information is the technology Augmented Reality (AR). In AR technology, users can visualize objects or historical objects in a 3-dimensional form. AR has the advantage of being interactive and real time so AR is widely implemented in various fields. In the field of education, AR is used as a medium for introducing historical objects that are cultural heritage [5]. Historical objects that become cultural heritage fall into the category of cultural heritage. Cultural heritage objects have a special meaning for history, science, education, religion, and culture. In addition, cultural heritage objects also have cultural values for strengthening the nation's personality [6].

## 2.3 Industry Revolution 4.0

The term Industrial 4.0 was born from the idea of the 4th industry revolution. European Parliamentary Research Service in Davies 2015 conveys that industrial revolution takes place four times. The first industrial revolution took place in the United Kingdom in 1784 where the invention of vapour engines and mechanization began to replace human occupation. The second revolution occurred at the end of the 19th century where power-powered production machines were used for production activities effectively. The use of computer technology for the third manufacturing automation. Today, the rapid development of these technologies into various industrial areas. This is what is predicted to be the next industrial revolution. The number four on Industrial 4.0 terms refers to the 4th revolution. Industry 4.0 is a unique phenomenon if compared to the three industry revolutions that precede it. Industry 4.0 was announced in advance because the actual occurrence has not occurred and is still in the form of ideas [7].

The term 4.0 Industry itself was officially born in Germany precisely when she hosted the Hannover Fair in 2011[8]. Germany has a great interest in this regard as Industry 4.0 is part of its development design policy called High - Tech Strategy 2020. The policy aims to defend Germany to always be the forerunner in the manufacturing world [9]. Some other countries also participate in the Industry 4.0 concept but use different terms such as Smart Factories, Industrial Internet of Things, Smart Industry, or Advanced Manufacturing. Despite having a different term but has the same aim of increasing the competitiveness of the country's industry in the face of a very dynamic global market. The

situation is due to the rapid development of digital technology users in various fields. Industry 4.0 is predicted to have great potential benefits.

### 2.3.1 Internet of Things

Today, only some of a manufacturer's sensors and machines are networked and make use of embedded computing. They are typically organized in a vertical automation pyramid in which sensors and field devices with limited intelligence and automation controllers feed into an overarching manufacturing-process control system. But with the Industrial Internet of Things, more devices of sometimes including even unfinished products that will be enriched with embedded computing and connected using standard technologies. This allows field devices to communicate and interact both with one another and with more centralized controllers, as necessary. It also decentralizes analytics and decision making, enabling real-time responses.

Bosch Rexroth, a drive-and-control-system vendor, outfitted a production facility for valves with a semiautomatic, decentralized production process. Products are identified by radio frequency identification codes, and workstations "know" which manufacturing steps must be performed for each product and can adapt to perform the specific operation [10].

### 2.3.2 Augmented Reality

Augmented Reality is an image technology that will appear on the LCD screen, computer, tablet or smartphone if an object is identified. For example, when a smartphone user scans the contents of a book, the animation will appear in 3D. Post Malaysia Berhad uses this technology when selling "Card Raya" in 2017. When users scan the bar code on the card, they will be able to watch video, music and images on the card.

A popular "shocking Pokemon Go" game of the past is an example of Augmented Reality. The IKEA company also uses this technology when customers can identify the size of the furniture to be purchased and match it to the indoor space where the placement of the furniture will be matched only by using a tablet or smartphone [1].

## 2.4 Learning Methods

Learning is the process of acquiring new, or modifying existing, knowledge, behaviours, skills, values, or preferences. The ability to learn is possessed by humans, animals, and some machines; there is also evidence for some kind of learning in some plants. Some learning is immediate, induced by a single event, but much skill and knowledge accumulates from repeated experiences. The changes induced by learning often last a lifetime, and it is hard to distinguish learned material that seems to be "lost" from that which cannot be retrieved.

### 2.4.1 Conventional Learning Methods

There has been a growing concern for transformation, modernisation and restructuring of education system globally. [11] has investigated the impact of educational software on technology-mediated learning to enable better teaching/learning transformation in the Information Communication and Technology driven world. The study highlighted the use of educational software as a product of technology in alleviating the pressure and difficulties faced in the use of conventional face-to-face teaching method that have hitherto impeded the growth of education system in Nigeria. Massive Open Online Courses (MOOCs) was adopted for this research and blended with the face-to-face teaching method.

Furthermore, [11] mentioned that research questions and corresponding hypotheses were formulated to guide the investigation. The study was anchored on Connectives theory. Experimental research design was adopted with a random sample of 120 first year Accounting university students, randomised into three groups (educational software technology, conventional teaching method, and blended educational software technology with conventional teaching method). Each group learnt Introduction to Financial Accounting, Computer and Entrepreneurship. Data were collected using a highly reliable and valid Introductory Financial Accounting, Computer and Entrepreneurship Achievement Test. The examinees' pre-test and post-test scores were subjected to Analysis of Covariance (ANCOVA) to test the hypotheses at 0.05 level of significance. Results showed statistically overwhelming effect of the treatment as the group that employed Educational Software Technology (EST) performed significantly better than the group that blended educational software technology with conventional teaching method, which in turn, made a substantially greater achievement than the group that adopted conventional teaching method [11].

### 2.4.2 21<sup>st</sup> Learning Methods

There has been a significant shift in advanced economies from manufacturing to emphasizing information and knowledge services. Knowledge itself is growing ever more specialized and expanding exponentially. Information and communication technology is transforming the nature of how work is conducted and the meaning of social relationships. Decentralized decision-making, information sharing, teamwork and innovation are key in today's enterprises. No longer can students look forward to middle class success in the conduct of manual labour or use of routine skills - work that can be accomplished by machines. Rather, whether a technician or a professional person, success lies in being able to communicate, share, and use information to solve complex problems, in being able to adapt and innovate in response to new demands and changing circumstances, in being able to marshal and expand

the power of technology to create new knowledge and expand human capacity and productivity.

Notwithstanding, research during the last decade has shown how new social practices evolve due to increased use of new digital technologies, especially among young people [12]. Such practices create re-conceptions of key skills, not defined from a systems level, but from the everyday lives of people in our societies. One example is research done on computer games and online communities, where problem solving is defined as a key component of such practices. Such experiences of problem solving among young people need to inform us in the way we design assessment tasks and define key skills.

Hence, new standards for what students should be able to do must replace the basic skills and knowledge expectations of the past. To meet this challenge schools must be transformed in ways that will enable students to acquire the sophisticated thinking, flexible problem solving, collaboration and communication skills they will need to be successful in work and life. New conceptions of educational standards and assessment, the subject of this white paper, are a key strategy for accomplishing the necessary transformation. Such standards and assessment can both focus attention on necessary capacities and provide data to leverage and evaluate system change. Technology also serves as both a driver and lever for the transformation [11].

**Table -1:** Difference between Conventional and 21<sup>st</sup> Century Learning Methods

Conventional Learning Method	21 <sup>st</sup> Century Learning Method
Learning or studies refer to the teaching using chalk and board.	Learning in their WIFI world
Searching by book.	Learning using Technology which is searching by internet.
Learning by themselves without cooperation.	Example searching in Google, Mozilla Firefox, Explores and etc.
Spoon feed by teachers/ lecturers	Learning or study by grouping.

Table 1 above shows the difference between Conventional and 21<sup>st</sup> Century Learning Methods that the Conventional Learning Methods is learning by using old methods and the 21<sup>st</sup> Century which is learning methods has transformed from the conventional to the modern learning methods.

## 3. METHODOLOGY

This section will discuss on the methodology of Mechanical Workshop Practice Acquainted through Augmented Reality. It begins with the prototype development, prototype testing and analysis using pre and post-test.

### 3.1 Prototype Development

At this stage prototype will be developed. First, create an account in HP Reveal application and setting the QR code for scanning trying with a simple or short tutorial. Then, edit the video, fill the information, and label parts in picture and video as much as simple. Next, upload it to the application and setting each tutorial with different triggers and overlay.

### 3.2 Prototype Testing

Prototype testing has been tested among lecturers and students. Then, a survey of satisfaction and effectiveness regarding Mechanical workshop practice acquainted through AR among students has been done using questionnaire. Consequently, researcher has improved and gain more information based on the feedback and comment given by students.

### 3.2 Analysis procedure

Analyze the questionnaire that fill up by respondents while prototype testing. Then, pre and post- test was executed in order to measure the effectiveness of Mechanical Workshop Practice Acquainted through Augmented Reality's poster. The result of analysis will be discussing in the net section.

## 4.0 ANALYSIS AND DISCUSSION

The analysis reveals the results of pre-test and post-test of mechanical workshop practice acquainted through augmented reality . In the beginning, most students were not very well-informed and lack of knowledge about the mechanical workshop practice. The result shows the lowest mark (0-39%) was obtained by the students is is 62.5%, whereas moderate mark (40-49%) was 37.5%. Suprisingly no highest mark (70-100%) obtained by the syudents. After using Mechanical workshop practice acquainted through augmented reality's poster, the students eventually developed a great interest and get deep explanation thorough mechanical workshop practice's poster. As a result there was a huge improvement when there was 70.83% respondents score the highest marks as shown in figure 2. The difference between the marks of pre-test and post-test shows that this project provides an immense benefit for the students and helps them to have a better understanding of mechanical workshop practice.

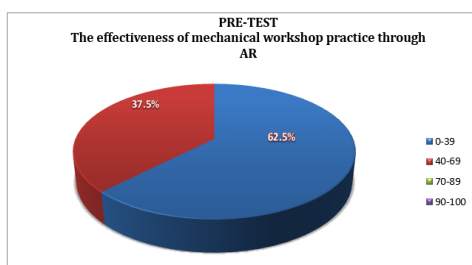


Figure 1: Pie chart for Pre-Test

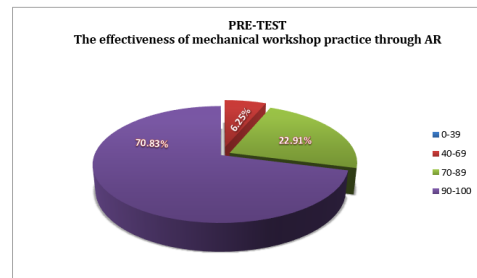


Figure 2: Pie chart for Post-Test

The rapid development of hardware and software use of augmented reality in engineering is becoming more and more adopted. In this paper, we present current trends in use of AR application. AR application offers numerous opportunities for integrating and improving conventional methods used in the fields of mechanical engineering.

The students could generate a new way in learning and education through Augmented Reality in order to create an interesting surrounding of education. Students can improve their understanding about tools usage and operation of machines in mechanical workshop practice just by using AR and not fully rely on the lecturer to upsurge their understanding about mechanical workshop practice. Furthermore, student could also gain some knowledge about technology in how to use AR by using QR Code and HP Reveal.

All in all, researcher believe that this project could give exposure to everyone in terms of the usage of augmented reality. Besides, the effectiveness of mechanical Workshop Practice Through AR has been measured through pre and post-test. As a result, it indicated that this project give impact to respondents and help to enhance the understanding of mechanical workshop practice knowledge.

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