



## Development of Chiller Simulation System

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### ABSTRACT

Each student got their learning style. In skills institutions, students' learning styles are more visual and kinesthetic than auditory. This is because teachers who do not diversify the teaching system will impact their students. Besides, students will become bored and lose focus due to non-interactive teaching sessions. Teaching aids also act as a tool that can provide fun and a more profound interest in teaching content. Moreover, the application of high-tech skills that match with the era of the industrial revolution 4.0 will improve skills and knowledge. This study aims to improve the teaching quality for the Course DMC2333 Water Cooled Chiller and Air-Cooled Chiller course. In this study, researchers have chosen the ADDIE design model as a guide in developing this product. The evaluation was done using a questionnaire that has been certified by three experts in mechanical, especially in the field of Refrigeration and Air Conditioning. The items developed by the researcher are divided into three primary constructs, which are design, development, and functionality. Each section was divided into several things that help in answering the research questions. The findings found that all experts agreed with the items in the questionnaire. However, there are also comments and suggestions for improvement attached by each expert. The results of these comments and enhancements can help researchers further improve the product's effectiveness in the following study.

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## 1. INTRODUCTION

Each student has their own learning style such as auditory, visual and kinesthetic. According to a study conducted by Hanif, *et al.*, 2017. teachers not diversify the teaching system will impact their students. Student become bored and lose focus due to non-interactive teaching session. The application of new technology in class with the element of industrial revolution 4.0 will enhance students' skills and knowledge (Souza and Sommer, 2017; Sulaiman, *et al.*, 2017). Purpose of the study is to improve the teaching quality by developing teaching aids for Refrigeration and Air Conditioning teachers in the DMC2333 Water Cooled Chiller and Air-Cooled Chiller Course (Arya & Chavda *et al.*, 2014). Researcher selected the ADDIE design model for this research. In Evaluation process, researcher chose 3 expertises from air conditioning sector and education sector to achieve all objectives stated in this reaserch. The questionnaire was developed for 3 expertise

## 2. METHODS

### 2.1 Analysis

- 1) Selected suitable system used in between Air Cooled System or Water Cooled System.
- 2) Selected right material for Dry Expansion Shell and Tube condensor type and Tube in Tube evaporator.
- 3) elected Two position control system in between two position, timed two – position and PID.

### 2.2 Design

- 1) Develop the conceptual design and product specifications in aspects of the for learning enviroment, compact, safe to use and precise data generated.
- 2) Suggested three different design consists of different characteristics that contribute to different aspects such as safety and easy to develop.
- 3) Referred to three different experts.
- 4) Built final design (see **Figure 1**).

### 2.3 Development

- 1) Developed the essential cooling system of the product.
- 2) Developed complete system with the base of the project, compressor, and metering device.
- 3) Programming was done after that to get the reading and also for the AR (see **Figure 2**).

### 2.4 Implementation

- 1) Tested the product to ensure can address the problem statement and achieve the objective.
- 2) Data collection forms for temperature and pressure readings were recorded.

### 2.5 Evaluation

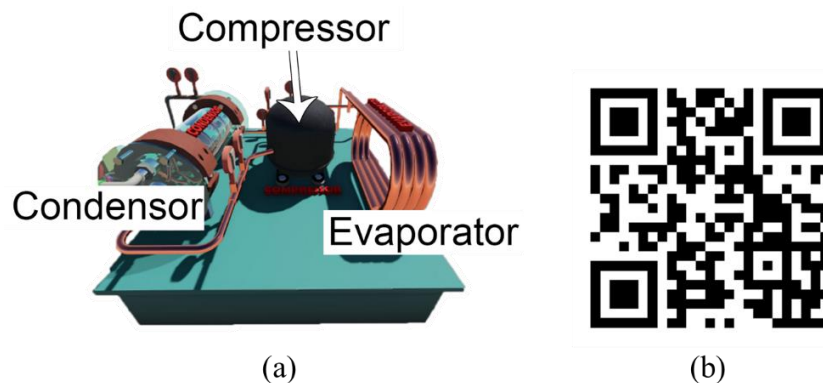
- 1) Used 'Yes or No' questionnaire form.
- 2) Selected two educators and a technician specialized in refrigeration and air conditioning for at least five years.
- 3) The questionnaire developed by the researcher is based on 3 aspects (design, development and functionality).

### 3. RESULTS AND DISCUSSION

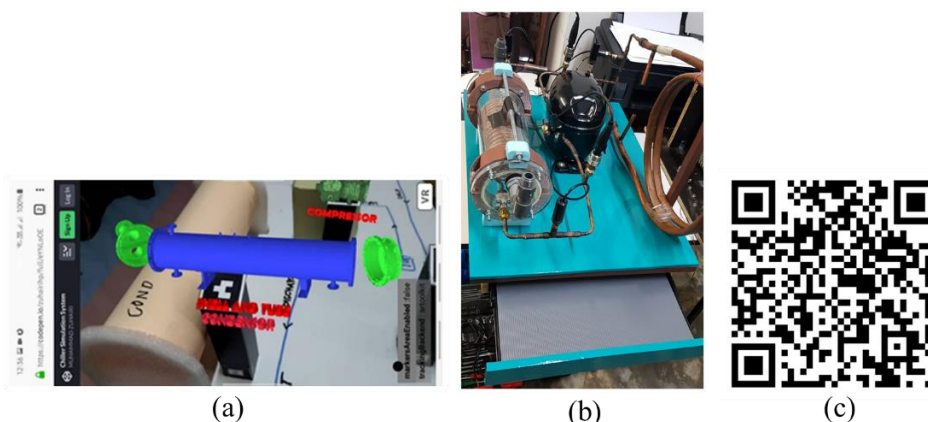
#### 3.1 Result

Three experts were responded based on the questions asked by the researcher. All three respondents agreed from the questions on the questionnaire as follows:

- 1) The design of this product could attract students to teaching and learning activity.
- 2) This product could detect changes in the physical changes of the refrigerant by displaying temperature and pressure readings.
- 3) This product is safe to use and easy for teachers and students to handle.
- 4) The material required by C.S.S. safe to develop and well designed.
- 5) The icon layout and readings on the user-friendly smartphone display.
- 6) The application used would provide convenience to students and teachers in explaining the performance of the chiller system based on the DMC2333 course.
- 7) This product could display temperature readings on the output of condenser, evaporator, metering device and compressor.
- 8) The product could display pressure readings on the output and input of the compressor.
- 9) The button icon and reading display on this product is easy to understand and that all the buttons / icons in this app work well.



**Figure 1:** (a) 3D design for development process. (b) QR code to access 3D model concept.



**Figure 2:** (a) Augmented reality that shows each real main component. (b) Real project design (c) QR code to access project video.

### 3.2 Discussion

The use of acrylic plastic as a condenser can help students to understand Shell and Tube type condenser. Who believe that physical properties of teaching aid can help students selecting the right material, labeling and easy to understand can improve the quality of teaching (Azman et al., 2014). Augmented Reality (AR) technology can help show the actual components and use of IoT-based applications and makes it easier to show students readings (Juhász et al., 2019).

### 4. CONCLUSION

With the Chiller Simulation System, the instructor can run the DMC2333 subject and teaching smoothly and effectively. This product has also been successfully developed and all the stated objectives have been accomplished. Characteristic of good teaching aid has been implemented in this system to help students in understanding the system.

### 6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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