

Development of Cooling Tower Teaching Aids with Augmented Reality Element

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ABSTRACT: Using teaching aids in teaching and learning sessions will help students understand the lesson more effectively. One of the approaches used to help students understand the substance of a teaching principal is teaching aids. This study aims to enhance teaching quality by creating teaching aids with augmented reality (AR) elements for the cooling tower subject in refrigeration and air conditioning (RAC). This study proposes developing an AR teaching kit using ADDIE models to increase students' knowledge of RAC technology. An expert survey is conducted to evaluate the usability of the teaching kit based on the given score. Based on findings shows the positive usability score obtained from the expert validation. This AR teaching kit may facilitate teachers throughout the teaching and learning process.

Keywords: Cooling tower System, teaching aid. Augmented reality

1. INTRODUCTION

The effectiveness of each Teaching Aid Tool does not depend on the material selection or how the aid tool was created, but its turn to how well the student can learn from it. According to Bakar and Aziz [1], the use of effective teaching aids facilitates the students' understanding of concepts and involves the interest and curiosity of the students.

Nowadays, the use of Augmented Reality (AR) is not something new. Many social apps use AR technologies to make stunning visual effects on their apps in the entertainment sector. This method is very suitable to put in the field of education. Based on Elmqaddem [2], the use of AR can change the teaching and learning model that satisfies the learner of the 21st century. The researcher developed teaching aids and AR interfaces fused to make this research's teaching and learning environments more significant.

On the other hand, students might have limitations in accessing actual teaching aids to improve their understanding due to the online approach. The 2D viewpoint of the teaching aids can be replaced by 3 dimension model using AR technology. This model can show any angle of view that students like to explore. Majeed and Ali [3] shows that this method can improve students' critical and analytical thinking.

This paper also aims to develop teaching aids that can get pressure and temperature readings on the cooling tower system and visualize the model using Augmented Reality using a smartphone. This product can help students understand how the tower cooling system works and improve the ability of teachers to deliver knowledge

and skills effectively. Furthermore, this product can help reduce costs for the administration in preparing teaching aids for that particular subject.

This research aims to design & develop Teaching Aids of Cooling Tower Operation to display the water's data readings during operation and the AR model. Lastly, the functionality of the Teaching Aids was verify using expert validation.

2. METHODOLOGY

The development of this instructional was based on the ADDIE development model. ADDIE stands for Analysis, Design, Development, Implementation and Evaluation, representing the essential phases in developing an excellent instructional kit. According to Aldoobie [4], the ADDIE model is widely used for efficient teaching design guidelines.

2.1 Analysis

At this stage, the researcher determines the analysis need based on an existing problem such as learner problems, knowledge and skills requirements. The analysis process covers the issues faced, product requirements include the objective of developing the product. The analysis phase becomes the determinant of the 'input' selection that is the basis for the development of a product. The counter flow system was chosen because it is easier to develop. Next, a rotary type sprinkler component was selected because it splits water evenly. Finally, a small water tank has been used as it is easier to install with other components. It also has an almost similar design to the actual refrigerating tower.

2.2 Design

In this stage, the researcher determines the product's design concept based on the input from the analysis stage. Three sketches were produced to be evaluated based on product specifications. Figure 1 shows the final sketch that has been chosen.

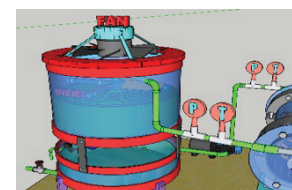


Figure 1. The Final sketch

2.3 Development

2.3.1 Development of Product

The product is created during this phase, and an evaluation, which is primarily for correction, is made and modifications are carried out if necessary.

Furthermore, The researcher develops the teaching kit according to the features in the design phase, which involves cost, materials, and safety aspects. These aspects should be applied to create an attractive, easy-to-carry and user-friendly teaching kit. In this phase, the researcher divided the development into several processes. At the beginning process, the researcher develops the body part of the cooling tower. Then, the researcher installs sensors to temperature and pressure on the product. The tower is fitted with all components such as infill, water dispenser, and fan. Figure 2a shows the actual product of the cooling tower system.

2.3.2 Development of IoT

Researchers use Arduino.ide and Blynk apps to programming the controller. The controller will gather all data from the sensors and uploading to the server. The smartphone will display the data in user interface. This data will show in appropriate unit such degree Celsius and pascal to monitor current condition of cooling tower. Figure 2b shows the interface of the Iot apps.

2.3.3 Development of Augmented Reality Model

To make the model more attractive, researchers use google Sketchup and Spark AR Studio to develop and fuse the model into the AR platform. This model can be displayed in any angle of view, whether close to each component or far away, to see full view of the model. To access the AR model, the student needs to scan QR links to open via facebook or instagram effect apps. Figure 2c shows the AR model of the product.

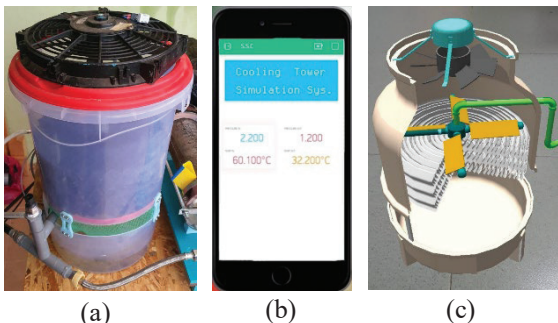


Figure 2:(a) Actual product of cooling tower, (b) IoT interface, (c) AR model of the product.

2.4 Implementation

In this stage, the product and the AR model are implemented temporarily to determine their impact on the real world. In this phase, testing was also made on the product based on the temperature & pressure data readings. This phase will also involve target users in which users will use this product before being evaluated by experts.

2.5 Evaluation

For this stage, the teaching kit will be evaluated from three aspects of the assessment: product design, product development, & functionality. Five experts consist of educators and technician with at least five years of experience in refrigeration and air conditioning to evaluate the developed product. The evaluation of this product is in the use of a questionnaire.

3. RESULT AND DISCUSSION

Results show that all experts agree that the product's design meets the interest to students and the materials used for product development are also good. Ultimately, all respondents agreed that this product is safe and easy to operate without teachers and students requiring specialized expertise.

Next, the respondent believes that the material chosen is safe to use and that the part configurations in the product are also suitable. In addition, all experts also agree that the icon layout and reading on the smartphone display are user-friendly. Finally, the app can also provide an opportunity for students and teachers to understand the system efficiently.

The final part of the results shows that all experts agree that the product can view temperature and pressure readings at the cooling tower's output and input. Additionally, they agree that the AR model was an excellent design and met the learning content's needs.

Based on the result, this product including an AR model interface that can enhance student understandings during the teaching and learning process. The advantage of using AR is the student can build a strong connection between object and the student to become more feel into the object [5].

4. CONCLUSIONS

Overall, the analysis result found that the development of cooling tower teaching aids archived every objective that been stated. The development of AR teaching aids also improves the teaching and learning process. The benefit for the instructor, these teaching aids can perform in every environment which is face to face mode or online conference mode.

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REFERENCE

- [1] Z. A. Bakar and N. Aziz, "Kesediaan Mengajar Dalam Kalangan Pelajar Tahun Akhir Pendidikan Teknikal Dan Kejuruteraan Fakulti Pendidikan Di Universiti Teknologi Malaysia, Skudai.," 2011.
- [2] N. Elmqaddem, "Augmented Reality and Virtual Reality in Education. Myth or Reality?," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 14, no. 03, 2019.
- [3] Z. H. Majeed and H. A. Ali, "A review of augmented reality in educational applications," vol. 7, no. 62, 2020.
- [4] N. Aldoobie, "ADDIE Model Nada," *Neuphilologische Mitteilungen*, vol. 5, no. 3, pp. 68–72, 2015.
- [5] N. Vasilevski and J. Birt, "Analysing construction student experiences of mobile mixed reality enhanced learning in virtual and augmented reality environments," vol. 28, pp. 1–23, 2020.