

Cooling Tower System As Teaching Aids Tools For Vocational College and Air Conditioning Technology Program

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Abstract: The research was conducted to develop a cooling tower system as teaching aids tools for vocational college and Air Conditioning Technology Program. The research was done to enhance student understanding about cooling tower system. In this study, researchers have used the ADDIE model as a guide to develop a cooling tower model. Next, the product was verified by five experts once developed. The result showed the product design is good as a portable cooling tower system, and also suits the usability as teaching aids tools. In conclusion, this cooling tower system can be used during teaching and learning sessions and can facilitate students' understanding of the cooling towers subtopic. Besides, this cooling tower system can be introduced for the purpose of upgrading and can be applied in vocational college, vocational school secondary school, public and private institution of higher learning.

Keywords: Cooling Tower System, Teaching Aids Tools, Air Conditioning Technology

1. Introduction

Effective teaching and learning can be seen through the extent to which teachers' ability to produce interactive teaching and learning process (Kamarul Azmi & Ab. Halim, 2007). Teaching and learning methods that used only chalk and textbooks have now been replaced by the use of more effective and interactive teaching tools. Teaching Aid Tools (ABBM) is a tool for strengthening and enriching knowledge and is able to help students remember the lessons learned and further enhance their existing knowledge. The production and use of teaching aids (ABBM) is an important thing to ensure the teaching and learning process becomes more interesting and effective. ABBM is very important to be applied in the current teaching and learning process. The process of teaching and learning will be meaningful if all the information that is wanted is easily understood and used by the students as best they can. The use of Teaching Aids (ABBM) can be seen in all technical and vocational subjects in line with the aid of models or materials as well as helping to achieve the objectives set. There are problems in engineering subjects in high schools or colleges, which are difficult to understand engineering terms,

conceptualization problems and inappropriate teaching and learning methods in the classroom (Wan, 2000). Hence, the model or the actual material can be used as an ABBM to help achieve learning objectives.

According to Ruhizan et.al (2012) study, he says that vocational subjects are a very difficult module for a student to master because of a low level of imagination, not understanding concepts and principles if oral learning is a traditional method of delivery. Students who are in the technical and vocational flows need the knowledge of skills to apply when they are in the industry someday. The method of teaching and learning using the simulation is a teaching method that affects students' attention during the P & P process, especially in the areas of art, science and engineering (Mook Soon Sang, 1991). Lack of equipment or teaching materials can cause problems for students to understand and apply engineering concepts and principles. Similarly, Air Cooling Technology and Air Conditioning programs are offered at vocational colleges. On most topics that need to be taught requires teaching aids (ABBM) to give students the opportunity to view, touch, feel and approach themselves and solve the problem of students to better understand abstract things. lack of teaching aids (ABBM) in particular relating to the Cooling Technology and Air Conditioning Technology program and cause the teaching and learning process to be implemented over a relatively long period of time. Thus, the idea of designing a teaching aids (ABBM) cooling tower has been based on the true model of the cooling tower. The teaching aids (ABBM) cooling tower has been designed with mobile features to be easy to use in the teaching and learning process. Additionally, teaching staff can also explain more easily and clearly as students themselves can see on their own how the cooling tower system works.

1.1 Problem Statement

The use of teaching and learning materials can generate four (4) stimuli such as seeing, feeling, hearing and touching and helping to enhance student interest. If the teaching and learning process is only conducted in college, students will quickly become bored and not interested in learning. A teaching tool design (ABBM) needs to be developed for students to better understand the topic of cooling tower. With the design to come, students will be able to have their own experience and see more about the cooling tower including how the system works and the components used.

2. Methodology

A product to be developed must be carefully and systematically planned so that the end result will be perfect. In this study, researchers have chosen to use the ADDIE Model as a guide to develop a cooling tower model. This chapter describes the rules that have been applied to develop the cooling tower as ABBM. A few things to keep in mind are the material selection for the inlet model. The material selected should be of high quality and durable material. Researchers have created the model drawings as a preliminary design and positioning of the components of the cooling tower. These include the provision of basic tower framing, cutting and connecting electrical wiring as well as the ABBM that has been manufactured.

2.1 Analysis

The researcher has analyzed the background of the problems and objectives of the study to provide guidance in the process of developing the teaching aids (ABBM) of the Cooling Tower. The problems that had been identified were the ABBM needed to assist lecturers in the Air Conditioning and Refrigeration Technology program. The focus is on the subtopic of the cooling tower. Several methods such as questionnaires and reading results have been used to analyze the problem. After the analysis, the researcher has implemented the process of gathering information and ideas. The process of developing the model has been implemented in accordance with the framework to ensure that everything is within a set timeframe.

2.2 Design

The researcher was able to identify the problem that occurred based on the analysis of the questionnaire. Based on the problem being analyzed, the researcher has decided to design a teaching

assistive device (ABBM) on the cooling tower, which is part of the external system for the finished air conditioning unit. The ABBM design to be developed includes all the components and systems found in the cooling tower. The design of the ABBM that is to be developed is similar to the situation as well as the actual design of the cooling tower to provide students and educators with experiences such as operating the real system. Key factors in the design and suitability of materials for the ABBM to be produced have also been considered. Some of the most important things to consider are cost, security, size, functionality, portability and so on.

Table 1: Specification Schedule and Design Criteria

No.	Title	Description
1	Ergonomic	The product to be manufactured must be comfortable and user-friendly. To meet this criteria, the ABBM kit produced must work well and user-friendly.
2	Safety	Designs should be safe to use. All sharp sections should be well protected and trimmed.
3	Durability	The product developed should have a long shelf life and be resilient to the work performed. Researchers also tested the materials used to ensure that the material used was durable.
4	Weight	The product produced should not be too heavy and easy to handle. This is to make sure it's easy to use anywhere.
5	Cost	Cost is a very important factor in a product's production. Too high a manufacturing cost may result in less product being produced.
6	Tidiness	The tidiness factor is important to ensure that the product produced is beautiful, neat and attractive. To meet this criteria the researcher will ensure that each extension or listing is properly affixed.

2.3 Development

In this phase, the researcher has undertaken a process of developing a simulation of the cooling tower model as a teaching tool by first providing the model site followed by the basic system part and subsequently the water cooler system. Development here refers to the process of developing or producing a product using selected sources and raw materials. Development usually goes through a number of processes such as material preparation, measurement, cutting and installation of components and other processes before it becomes a usable product. In the development phase, there are some important things to consider: finance, media resources, manpower, time and so on. The development phase also refers to several key areas of product development and product testing.

2.3.1 Project Material Selection

In this phase of product development, material selection is one of the most important things to consider. This is to ensure that the materials selected are appropriate and of good quality to develop a product. Among the materials selected in the development of this product are:

- (a) Acrylic
Acrylic is used to build the structure of the cooling tower system.
- (b) Wooden board
The wooden board is used as a base (table) to place the entire teaching kit on the cooling tower.
- (c) Iron
The iron is used as a base for the entire teaching kit for the cooling tower to be developed.
- (d) PVC Type Pipe
PVC pipe is used to build water drainage in cooling tower system.

2.3.2 Initial Sketch Of The Project

In this process, the researcher has developed a project design sketch that will be developed as a teaching aid. The drawings are based on the relevance as teaching aid and several other aspects such as ergonomics, safety and aesthetic value that a product should have.

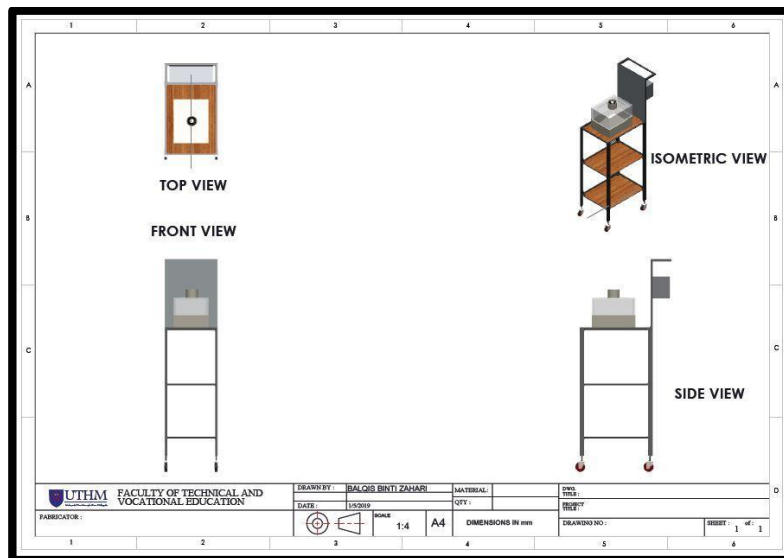


Figure 1: The drawing of product according to the top, side and front view

2.4 Implementation

In the design of cooling tower designs, there are a number of specific processes involved. This process can be divided into several main sections: the structure of the cooling tower frame, site as a table for the frame of the cooling tower, plumbing system and electrical system. In this phase, the researcher performs several tests on products such as leakage tests, functional tests, and tests for the entire system once the model has been developed. The purpose of these tests is to ensure that there are no problems or failures in the developed Cooling Tower as a teaching tool.



Figure 2 : Final product

2.5 Evaluation

The evaluation phase is where the researcher will conduct an assessment of the design and functionality of the cooling tower to be used as a teaching tool in the R&D process. This evaluation is done to test the effectiveness of the product and to see if there are any problems with the product. The expert will provide insights and opinions on the improvements that can be made to the teaching aid that has been produced. Any ideas or insights from experts can be used by researchers to refine and improve the product they produce. It can also be used as a suggestion for further study. The evaluation phase is carried out in two forms, namely the test and using the evaluation instrument, which is to use the questionnaire form.

2.5.1 Test

The study was to test the usability of teaching aid Cooling Tower System that was developed. ABBM The Cooling Tower System is viewed in terms of its functional capabilities to meet the needs of both the researcher and the user. This test is also done to see if there is any problem with this ABBM Cooling Tower.

2.5.2 Evaluation Instrument

The research instrument used by the researcher in assessing the feasibility of teaching aids (ABBM) Cooling Tower System is to use a questionnaire. The questionnaire was used to get feedback from three experts. This questionnaire is used to enhance the accuracy and accuracy of the study conducted. This questionnaire was distributed to three experts. Table 2 shows data analysis of elements of student interest in the cooling tower system as a teaching aid based on feedback from respondents.

Table 2: Analysis data of students' interest in cooling tower system as teaching aids

No.	Item	Yes		No	
		Total	%	Total	%
1.	The Cooling Tower System developed has an interesting color.	2	66.7	1	33.3
2.	The Cooling Tower System will interest students to learn the subtopics of the cooling tower.	3	100	0	0
3.	The Cooling Tower System developed helps teachers during the teaching and learning process.	3	100	0	0
4.	The Cooling Tower System helps teachers to diversify their activities in the classroom	3	100	0	0
5.	The Cooling Tower System promotes students' audio, visual and kinestatic activities during the learning session.	3	100	0	0
Total		14	93.3	1	6.66
			4		

Table 3: Data analysis of the contents of the tower system model as a teaching aids (ABBM) based on feedback from respondents.

No.	Item	Yes		No	
		Total	%	Total	%
1.	The Cooling Tower System is developed according to the subtopic symmetry of the cooling tower.	3	100	0	0
2.	Teachers can easily explain the content of the lesson using this Cooling Tower System.	3	100	0	0
3.	This Cooling Tower System can serve as a reference for the teaching and learning process.	3	100	0	0
4.	The ABBM developed enables students to remember every process that takes place in the cooling tower system	3	100	0	0
5.	These ABBMs can help teachers practice the cooling tower system.	3	100	0	0
Total		15	100	0	0

3. Results and Discussion

In the study, the researchers have set the three main objectives of designing a portable cooling tower system that can be used as a teaching aids tool (ABBM), developing a portable cooling tower system that can be used as a teaching aids tool (ABBM) portable cooling tower system as a teaching aids tool (ABBM). To ensure that each objective is achieved, the researcher has created a research question based on each study objective. The first question raised is the design suitable for the portable cooling tower system which can be used as a teaching aids tool. After the design was successfully produced, the researchers were approaching to achieve the first objective of the study, namely the design of a portable cooling tower system that could be used as a teaching aids tool (ABBM). The designs chosen by the researcher are appropriate and meet the needs of both faculty and students. The process of teaching and learning will be more fun and can attract students to learn. Ahmad Zanzali (2010) states that the students' enjoyment of learning, skills or concepts that are easy to understand by students and the willingness of teachers to deliver teaching are the qualities of their teaching in school. In the design of this cooling tower system, researchers have highlighted some of the key aspects that need to be in a product development. Among the aspects emphasized are the functionality, ergonomics and the aesthetic value that need to be in the built-in cooling tower system. In short, the built-in cooling system requires carefulness and ease to help attract students to learn about operating systems of cooling towers. According to Hassan (2004), teaching aids are something that can be felt, seen, heard, colorful, attractive and can help students to develop the concepts learned properly. The main purpose of this design is to ensure that the built model is the same as the actual cooling tower system.

The second question is how are the methods used to develop the mobile cooling tower system as a teaching aids tool (ABBM). Researchers have made several divisions of work processes to develop a cooling tower system as a teaching aids tool (ABBM). This process is divided into the main parts of the cooling tower frame structure, the site as a table to lay the frame of the cooling tower, piping system and electrical wiring system. Researchers have chosen to use the ADDIE Model as a guideline for developing cooling tower models. The ADDIE model is suitable for building a module or product. This statement is supported by Nasohah, Abd Gani and Md Shaid (2015) which states that the ADDIE model is composed of some of the best phrases that can be applied to develop a course of teaching modules.

The final question of the study is whether the usability of the portable cooling tower system as teaching aids (ABBM) can work well? In response to the questions of this study, researchers have obtained confirmation from experienced experts in the field of refrigeration and air conditioning. These experts have confirmed that this built-in cooling tower system works well and is suitable for teaching aids. Although the size of the cooling tower is smaller than the actual object, the concept and operating

system is the same as the real cooling tower. This coincides with the fact that Velenis, Stucchi *et al.* (2010) states that the model is a three-dimensional visual impression material in which it is able to illustrate the real object.

4. Conclusion

In conclusion, all set objectives have been achieved and this cooling tower system has also been successfully developed. This cooling tower system has been developed through several processes ranging from the process of obtaining information, identifying materials to the production of cooling tower systems as a teaching aids tool. Therefore, the researcher hopes that this cooling tower system will assist teachers and students in the vocational college in teaching and learning sessions. Researchers also hope that this cooling tower system can be used during teaching and learning sessions and can facilitate students' understanding of subtopic cooling towers. Finally, the researcher also hopes that this cooling tower system can be introduced for the purpose of upgrading and can be applied in vocational college, vocational school secondary school, public and private institution of higher learning.

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