



RITVET

Homepage: <http://publisher.uthm.edu.my/periodicals/index.php/ritvet>
e-ISSN : 2785-8138

Simulation of Basic Air Conditioning System

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DOI: <https://doi.org/10.30880/ritvet.2021.01.02.017>

Received 23 May 2021; Accepted 08 June 2021; Available online 28 September 2021

Abstract: The purpose of this study is to design and develop a simulation product of basic air conditioning system for teaching aids purposes complete with basic air conditioning components such as compressor, condenser, metering device and evaporator. This product is developing purposely for the course MPP1013 (Introduction to Refrigeration and Air Conditioning). This subject is taken by the first-year student and usually facing difficulty to understand about the air conditioning system. Additional simulation about the basic concept air conditioning system might improve student understanding and increase their interest. Through this simulation, it can enhance student understanding about the components that are available in the air conditioning system and explain how the air conditioning system works. This product also can assist teachers in transferring information more easily during the teaching and learning process. Researchers have chosen ADDIE Model as a guide in developing the product design of a basic air conditioning system product simulation as a teaching aid. Five experts in Heating, Ventilation and Air Conditioning were selected by the researchers to provide feedback on the product design of the basic system of air conditioning systems as teaching aids. Overall, this basic air conditioning simulation product design as teaching aids is suitable for use during theoretical and practical learning for the course of MPP1013.

Keywords: Simulation Air Conditioning System, Teaching Aids Tools, Air Conditioning Technology, Basic Air Conditioning System

1. Introduction

The field of education is one of the areas that is not exempt from the rapid changes in globalization. Changes in education in line with technological advances can make the teaching and learning process (T&L) more interesting and effective. According to Yahaya (2009), the teaching aids is an excellent tool for teachers to use it across school institutions as their tools to assist them in delivering teaching

more easily. The availability of teaching aids using in the teaching and learning process can enhance the knowledge of the topics being taught and students will be more likely to remember the learning they have been through.

According to Hanif (2017), all technical teaching staff should always be concerned with the development of the current teaching and learning process in relation to teaching techniques and effective in student teaching and learning process. In addition, all these technical educators should improve and enhance the quality of the teaching and learning process in each institution by using various teaching aids to make a positive impact on students. In general, the teaching staff at Vocational College still use teaching aids which are not up to date with global development, resulting in less time constraints. Students will also lose focus due to the lack of interactive teaching and learning sessions. This study discusses the development of product design for simulation of basic air conditioning systems for MPP 10103 (Introduction to Refrigeration and Air Conditioning).

1.1 Problem Statement

The teaching and learning process for the MPP1013 (Introduction to Refrigeration and Air Conditioning) course will be difficult for students at 1st semester Vocational College to master the subject, because there are no effective teaching aids for the teachers and students to apply for learning and teaching process. Students cannot describe clearly about the basic cycles and processes that occur in the air conditioning system specifically related to the physical deformation of the refrigerant if the instructor does not use the appropriate teaching aids during the teaching process.

In addition, there are some Vocational College students who have trouble learning and acquiring knowledge as stated by Muhd Ridzwan & Mansor (2014), the problem with students' weaknesses in learning is the complexity of a person's ability to memorize and calculate. Therefore, the use of appropriate teaching aids can assist students with the content of a subject becoming clearer and systematic (Rosli, 2018). In addition, the teaching and learning process for the MPP1013 (Introduction to Refrigeration and Air Conditioning) course requires appropriate tools to help make the learning process more effective for teachers and students. If the process of teaching and learning is only conducted in lecture, students will lose focus and interest in learning.

2. Methodology

A product to be developed must be carefully and systematically planned so that the end result will be perfect. According to Arif (2013), states research methodology refers to procedures or methods for implementing the development of a project design. To obtain good and quality data, the research method should follow its own processes and procedures. All the work that goes into collecting data needs to be followed without skipping or going through the procedure. This research enables researchers to carry out research more easily, effectively, and systematically in developing a product design of basic air conditioning system simulation products as teaching aids. Therefore, the researcher has selected the ADDIE Model as a guide in developing the model.

ADDIE model is a traditional generic process which has been used by many professional instructional designers for technology-based teaching. ADDIE model has been almost a standard for professionally developed, high quality distance education programs. This model consists of five stage development process which is Analysis, Design, Development, Implementation and Evaluation. This model has been chosen not because of the proven record of being widely used in teaching design, but also because of the opportunity for the continuous improvement in the development process.

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 Basic Air Conditioning system.

The researcher will get as much information as possible with the research topic. All factors and research needs are taken into account to facilitate the researcher in achieving the objectives of the study. Additionally, at this phase, the researcher will have stated the problem, identified the problem and stated the various ways to solve the problem. Therefore, the researcher has analysed the references by searching for information related to the product that has a method like the product to be developed and referencing the previous thesis. For the components, materials and systems that have been used in the production of the product, it will serve as a guide for the researcher to design the product of the teaching aids by focusing on the characteristics of effective teaching aids and touching all research objectives.

2.2 Design

Design is a necessary phase in the ADDIE model. This phase will show the advantages of the model or product. In addition, several designs need to be developed to evaluate functionality and diversity so that there are more options to achieve research objectives. The product design sketch that the researcher has prepared will be provided to the subject method expert to get opinion for improvement and to ensure this project is meeting the objective. Figure 1 shows the front view of the product. It shows all the basic components in the air conditioning system.

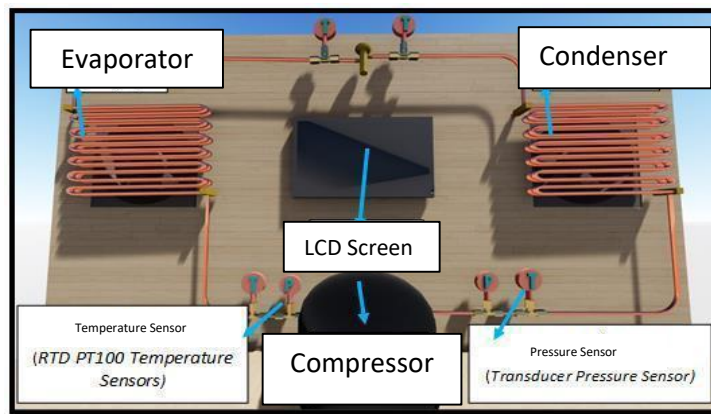


Figure 1: Front view product

Figure 2 shows the rear view of the product, which shows the location of the fan and the safety box for this product.

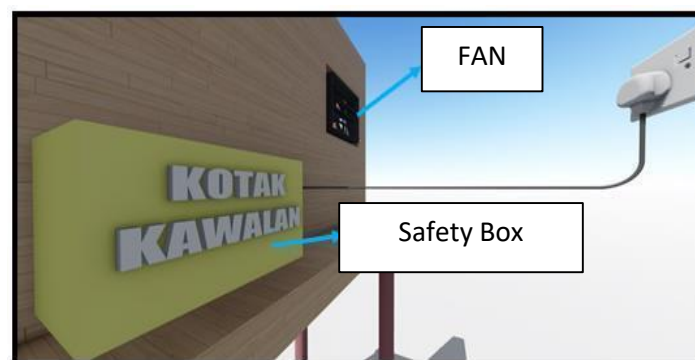


Figure 2: Rear view product

Figure 3 shows the layout for monitor screen display which can provide all the infographic information. The sketch provided by the researcher is to ensure that the product is able to achieve the objective of developing simulation of basic air conditioning system as a teaching aid.

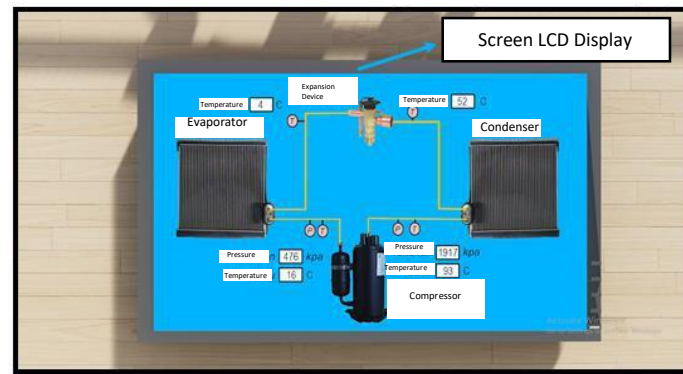


Figure 3: Monitor Screen Display

2.3 Development

In this phase, the researcher has undertaken a process of developing a simulation of the basic air conditioning system as a teaching tool by first providing the layout of the system followed by the function of every component. Development here refers to the process of developing or producing a product using the resources and raw materials selected by the researcher. This development usually goes through several processes such as material preparation, product measurement, material cutting and lastly component installations. This is all the process in the development stage before it becomes a product that can be used by users and researchers. On top of that, at this stage of development there are some important things to be considered such as financial, media resources, manpower and time management. As the conclusion, this development stage is one of the important parts in producing a product, including testing the product before release to be used.

2.4 Implementation

At this phase, the researcher will evaluate the effectiveness of their product from the subject matter expert. This process is to determine the suitability of the design, scope of design and suitability materials of product. Before the evaluation phase, the researcher needs to implement the design of the product to determine any problem in the product. Researchers will provide questionnaires for the evaluation process by the experts.

2.5 Evaluation

The evaluation phase is the final phase in which it is important to evaluate whether the simulation products of the basic air conditioning system as a teaching aid for the subject MPP10103 (Introduction to Refrigeration and Air Conditioning) were developed in accordance with the objectives of the study. The evaluation phase is also important to ensure that the product that is manufactured meets the specifications that have been applied to the product safely. To carry out this evaluation process, the researcher used expert verification methods to ensure this product can be used as a teaching aid. This subject matter expert verification is carried out to obtain an evaluation and validation of the product design that will be generated based on the expertise scores in the refrigeration and air conditioning field. In addition, this expert verification process is performed to obtain the expertise of the experts to identify the product's functionality and the suitability of the product that has been developed as a teaching aid. Data collection was performed using the research instrument that is questionnaire which contain product design analysis, product design suitability and design comfort analysis. This phase is essential to ensure the simulation product of the basic system of air conditioning as a teaching tool is fully functional and meets the requirements research objective.

3. Results and Discussion

All five experts have provided feedback based on the questionnaire form provided by the researcher. Each item of the question was analyzed by the researcher to obtain the level of product design, product design suitability and product design comfort.

Table 1: Product design analysis

No.	Item	Yes		No	
		Total	%	Total	%
1	Portable product design	5	100	0	0
2	Component position safe to use.	5	100	0	0
3	The temperature sensor is in a more optimal and safer position.	5	100	0	0
4	The pressure sensors are in an optimum and safe position.	5	100	0	0
5	The design has easy plumbing connectivity.	5	100	0	0
6	The design has a plumbing connection in order.	5	100	0	0
7	Design the position of the components in real life.	5	100	0	0
8	The position of safety box is in a safe place,	5	100	0	0

Based on Table 1, it can be said that all experts agree that the product design was developed with the intention of being portable by placing wheels on the product. The second question item in terms of safety was evaluated positively by all experts as the components and materials used did not pose any danger to students or teachers. In addition, the third and fourth question items were also agreed upon by all respondents as all temperature and pressure sensors were in an optimal and safe position.

In addition, all the respondents agreed to the fifth and sixth item questions with design having a simpler and more organized plumbing to facilitate students' understanding when using this product. Therefore, all the experts are also satisfied with the seventh item question, with the overall design being built because the position of the actual component is unchanged and in the correct condition. This makes it easier for students to do skills activities without any hassle. Finally, the last question item of all experts agreed that the safety box switch position was in the right place.

Table 2: Product design suitability analysis

No.	Item	Yes		No	
		Total	%	Total	%
1	This product design is suitable for use during the teaching and learning process.	5	100	0	0
2	This product design can improve student understanding.	5	100	0	0
3	This product design can create a two-way teaching and learning process.	5	100	0	0
4	This product design can attract students.	5	100	0	0
5	This product design can save time teaching and learning process.	5	100	0	0
6	This product design can help teachers convey the content effectively.	5	100	0	0
7	This product designs stimulate students' cognitive and the sense of student stimulation during the teaching and learning process.	5	100	0	0

Based on Table 2, it can be stated that all experts agree on the product's relevance as a teaching tool. All subject matter experts agree with the first and second question items that this product design is suitable for use during the teaching and learning process and will further enhance student understanding as the product design is attractive and structured. Besides that, all the experts agreed on the third question item with the researcher stating that this product design can create a two-way teaching and learning process on this product design. Therefore, all the experts also agree with the fourth question item, which is the design of this research product that will interest the students because of the attractive and unique design of the product.

Therefore, all experts agree with the fifth question item that this product design can save on the teaching and learning process as students will quickly understand the lessons taught by the instructor using this research product design. However, all experts agree with the sixth question questionnaire that the design of this product can help teachers convey the teaching content effectively as well as diversify the teaching method. Students can theoretically understand and apply what they have learned using this product design. All experts provide positive feedback on the last question item considering that the design of this product is very useful for enhancing the students' congenial and sensory stimulation in the teaching and learning process.

Table 3: Design comfort analysis

No.	Item	Yes		No	
		Total	%	Total	%
1	The basic cycle of the air conditioning process is clearly described.	5	100	0	0
2	Provides students the opportunity to understand the basic cycle of air conditioning components more easily.	5	100	0	0
3	Product design helps students to understand the function of each component clearly and easily.	5	100	0	0
4	Product design helps students to understand the function of each component clearly and easily.	5	100	0	0
5	Product design can help teachers and students because it is portable.	5	100	0	0

Based on Table 3, it can be stated that all experts agree on the aspect of product design comfort as a teaching aid that has been developed. All experts provided positive feedback from the questionnaire items. The first and second question items of the study were agreed upon by all experts who stated that this basic process of air conditioning is clearly described. This is due to the arrangement of the components of the basic cycle of air conditioning developed by the researcher in the order of the basic cycle process as in theory. Besides that, all researchers agree with the third question item of the researcher that product design can help students to understand the function of each component clearly and easily.

Because the researchers put the basic cycle component diagrams together with an explanation of the functions of each component in the product design. As for the fourth question item, all experts agree that the product design of the researcher is the right size for students and teachers to handle because the size used by the researcher is relatively small and easy to handle. Finally, the fifth question item all researchers agree is that product design can help educators and students alike because it is convenient because the product design researchers have the wheel to make the product easier to move and move around.

3.1 Implication

Product design simulation of basic air conditioning systems as a teaching aid is to focus on product development works to assist teaching and learning sessions in saving time and improving students'

understanding as well as applying future technologies. According to Hamdan and Yasin (2010), teaching aids are very useful in the world of education. Teachers need to be smart in providing teaching aids that can stimulate a student's interest and attention to further enhance their learning and teaching quality. The use of appropriate, innovative, and practical teaching aids can enhance the knowledge and understanding of Vocational College students pursuing Refrigeration and Air Conditioning programs related to the learning topic of this basic cycle system.

4. Conclusion

In conclusion, product simulation of the basic air conditioning system as one of the teaching aids that is in-line with the development of modern technology. This concept of technology is able to be a competitive product for facilitating teaching and learning sessions for vocational students and educators especially students for the MPP1013 course (Introduction to Cooling and Air Conditioning).

By making some improvements as suggested, this product can be introduced to other institutions with subject matter that has the same concept of this product. Simple specification and instruction make this product can be used widely and also has potential to increase the capability and efficiency. Overall, this product is capable of delivering a positive impact in many corners especially on education systems, which aim at producing highly skilled specialists in the field of refrigeration and air conditioning.

Acknowledgement

The authors would like to thank the Faculty of Technical and Vocational Education, Universiti Tun Hussein Onn Malaysia for its support.

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