DEVELOPMENT AND ASSESSMENT OF AIR-CONDITIONINGSYSTEM TRAINER (Air-CoST)

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Abstract: An air-conditioning system trainer for automobile air conditioning was developed and evaluated as part of this project. This trainer's goal is to give students and technicians actual, hands-on experience in learning the functioning and workings of an automobile air conditioning system. The development of the trainer included the design and construction of a compact and portable system that simulates the working conditions of a car air-conditioning system. The trainer consisted of various components, such as a compressor, condenser, evaporator, expansion valve, and refrigerant, which are interconnected with piping and electrical wiring. The trainer is equipped with sensors and gauges to measure and display the relevant parameters, such as temperature, pressure, and flow rate, of the refrigerant and air. The system is also integrated with a control panel that allows the users to adjust and monitor the system parameters.

The assessment of the trainer involved testing and evaluating its effectiveness in achieving the learning outcomes. The evaluation criteria included the students' comprehension and retention of the theoretical concepts, their ability to diagnose and troubleshoot the system faults, and their proficiency in performing maintenance and repair tasks. The assessment also considered the trainer's reliability, durability, and safety aspects, as well as its ease of use and maintenance. The feedback from the users was collected and analyzed to identify the areas of improvement and to optimize the trainer's design and functionality. The development and assessment of the air-conditioning system trainer provides a valuable tool for enhancing the students' and technicians' skills and knowledge in car air-conditioning. The trainer enabled them to gain practical experience in a controlled and safe environment, which prepares them for the challenges of the real-world scenarios

Keywords: air-conditioning system, instructional material, automotive students, automotive teachers, industry practitioners.

Chapter 1

THE PROBLEM AND ITS BACKGROUND

Introduction

The term “Automotive” pertains to the design, operation, manufacture, or sale of automobiles (Dictionary.com, 2022). The word automotive is known in the field of industry and academe. The automotive industry comprises a wide range of companies and organizations involved in the design, development, manufacturing, marketing, and selling of motor vehicles. It is one of the world's largest economic sectors by revenue (Definitions.net, 2022). On the other hand, automotive in academe is considered a course, program, or curriculum, well it depends on the nature of the academic institution offering it. Basically, it is called automotive technology. The Automotive Technology course is designed to prepare skilled technicians to work in the automotive industry. The program involves general education as well as automotive lecture and laboratory instruction focusing on state-of-the-art products. The students of this course participate in hands-on experiences in testing, diagnosing, and repairing automobiles. Emphasis in class and laboratory is placed on real-world, hands-on experience.

Also, this course provides the students with knowledge and skills in tune-up, brake system, electrical systems, lamp adjustments, lubrication service and parts management (Bpsu.edu.ph, n.d.). However, the air-conditioning system in the car is an additional specialization that can be taught in automotive technology. The air-conditioning system in a car works by manipulating refrigerant between a liquid and a gaseous state. As the refrigerant changes states, it absorbs heat and humidity from the vehicle and allows the system to give off cool, dry air. To change the refrigerant between a liquid and a gaseous state, the air-conditioning system works to control pressure and temperature (Universal Technical Institute, 2020).

In the United States of America (USA), there is a course related to car air-conditioning. This course was offered in Santa Ana College, California, USA. The Automotive Air Conditioning Maintenance Certificate is designed to prepare the student for employment in industry, servicing modern automotive air conditioning systems. Air conditioning theory, refrigerant handling, and practical hands-on experience are emphasized. This training assists the student in preparation for national ASE A7 and EPA 609 certification (Automotive Air Conditioning Maintenance Certificate, n.d.).

In the Philippines, the Department of Education (DepEd) mandate was refocused by the trifocal education system to include basic education, which includes non-formal education like culture and sports as well as elementary and secondary education. The Technical Education and Skills Development Authority (TESDA) now oversees middle-level postsecondary manpower training and development while Commission on Higher Education (CHED) is in charge of higher education. One of the qualifications offered by TESDA that is related in car air-conditioning system is the Transport Refrigeration and Air-Conditioning (RAC) Servicing NC II, it consists of competencies that a person must achieve that will enable him/her to install, service, maintain, troubleshoot and repair air-conditioning and refrigeration units in transport sector (TRANSPORT RAC SERVICING NC II - TESDA COURSE MODULE, 2022). Further, a person who has achieved this qualification is competent to be a Transport Air-conditioning and Refrigeration Technician.

Based on the experience of the researcher as an automotive instructor at the College of Industrial Technology (CIT) of Nueva Ecija University of Science and Technology (NEUST), he saw that the actual car was used for demonstration how the air-conditioning system of an automobile works. This kind of teaching-learning process is effective. However, it will be more effective if there is actually an instructional device whose functionality is focused on the air-conditioning system of a car. The problem is, this type of mechanism is rarely seen in schools that offer automotive technology. According to the researcher's investigation, there are these types of technology but only seen and used in the industry. In our country, there is no such instructional device that can be bought in the market. In other countries there is, but its price is high.

In this situation, the researcher thought of developing an improvised vehicle air-conditioning trainer that can be used by the teacher and students during the teaching and learning process. The materials that will be used in this instructional device will be improvised, fabricated and purchased by the researcher to ensure that the proposed product will be cheap with more comprehensive functionality.

Conceptual Framework

The proposed design of the Air-CoST, tools, materials and equipment, and the cost and benefit analysis covered the input stage. The design was drawn using computer-aided design software. Meanwhile the tools, materials and equipment used during the development process of the Air-CoST were the personal property of the researcher and the rest was borrowed from his friends and colleagues. On the other hand, the cost and benefit analysis of the study described the total costing of the project and its impact to its intended purpose.

The process stage covered the different procedures that the researcher needs to follow for him to be able to produce the proposed Air-CoST. The development phase is the actual construction, while the implementation phase is the actual deployment to its chosen research participants. Further, the evaluation phase is the actual assessment of the Air-Cost by the respondents and the revision phase is the actual modification or alteration of the researcher if there is a suggestion or comments from the research participants during the evaluation process.

The output stage was a fully developed Automotive Air-conditioning System Trainer.

Statement of the Problem

This research focused on the development and assessment of the Automotive Air-Conditioning System Trainer. Specifically, the study sought answers for the following research questions:

1. How may Air-CoST be developed according to the following stages of the IPO Model:
   - 1.1 Input;
     - 1.1.1 Design
     - 1.1.2 Tools, Materials and Equipment
     - 1.1.3 Cost and Benefit Analysis
   - 1.2 Process; and
     - 1.2.1 Development
     - 1.2.2 Implementation
     - 1.2.3 Evaluation
     - 1.2.4 Revision
   - 1.3 Output?

2. How may the Air-CoST will be assessed by the:
   - 2.1 Industry practitioners based on its technical characteristics based on ISO 25010 standards; and
     - 2.1.1 Functional Suitability
     - 2.1.2 Performance Efficiency
     - 2.1.3 Reliability
     - 2.1.4 Maintainability
     - 2.1.5 Usability
   - 2.2 Teachers and students based on its instructional capabilities?

3. How may the level of effectiveness of the implementation of the developed Air-CoST be described?
4. What are the implications of the study in the Bachelor of Industrial Technology program?

Scope and Delimitation

The study focused on the development and assessment of the Automotive Air-Conditioning System Trainer (Air-CoST). The development of the proposed Air-CoST was based on the phases of the IPO model. The materials utilized in the study were improvised, fabricated and purchased.

The proposed Air-CoST was assessed by the practitioners from the automotive industry on its technical characteristics according to the descriptor mentioned in ISO 25010 standards and teachers and students from the schools offering automotive technology on its instructional capabilities.

METHODS AND PROCEDURES

This chapter presents the methods and procedures used in the study. It includes the research design, research locale, research participants, population and sampling techniques, research instruments, research procedures, data analysis techniques and ethical concerns.

Research Design

The study used developmental research design. According to Richey & Nelson (2001) as cited by Pasion (2021), developmental research is the systematic study of designing, developing and evaluating instructional programs, processes, and products that must meet the criteria of internal consistency and effectiveness. Additionally, developmental research is the examination of the instructional design, development, and evaluation process in its entirety or with respect to specific process elements (Richey, Klein, and Nelson).

Developmental research is reportedly particularly significant in the area of educational technology. This study also made use of one of the most popular kinds of developmental research design: the product-development approach, in which the generated product is examined, explained, and then assessed.

In this study, the Air-CoST was developed following the phases specific to product development and the model used.

Participants

There were three groups of respondents in this study. The first group consisted of industry practitioners who assessed the technical characteristics of the Air-CoST with respect to functionality, efficiency, reliability and usability as well as maintainability.

The second group consisted of the automotive technology students who assessed the Air-CoST in terms of instructional use.

The third group were automotive technology teachers who evaluated the Air-CoST based on instructional use, too.

The aforementioned participants were chosen purposively based on the intent for which the Air-CoST was developed. The industry practitioners were automotive technicians which specialize in the car air-conditioning system within the city of Cabanatuan and San Jose, Nueva Ecija.

The second and third group was chosen on the basis of their direct experience and involvement in the teaching and learning process. These respondents were from the College of Industrial Technology of Nueva Ecija University Science and Technology, Provincial Manpower Training Center and the Don Bosco Training Center.

Sample and Sampling Procedure

Purposive sampling refers to a group of non-probability sampling techniques in which units are selected because they have characteristics that you need in your sample. In other words, units are selected "on purpose" in purposive sampling (Nikolopoulou, 2022). Also, this sampling technique, also known as judgmental sampling, focuses on the researcher's judgment when determining and choosing the people, cases, or events that can supply the most information to meet the research objectives.

Further, in qualitative research and mixed-methods research, purposive sampling is common. Finding cases with lots of information or making the most of little resources are two situations in which it is especially helpful. The researcher believes that he can obtain a representative sample by using a sound judgment, which will result in saving time and money.

Data Gathering Instrument

The study utilized a research instrument to three groups of respondents: industry practitioners, and automotive technology teachers and students. They were asked to rate the technical characteristics of the proposed Air-CoST, based on some ISO 25010 standards such as functional suitability, performance efficiency, reliability, maintainability, and usability.

The research instrument was self-made by the researcher and has two (2) parts. The first part determined the type of the respondents. While the last part, provided the twenty-five (25) descriptors of the technical characteristics of the Air-CoST and they will be distributed.

Validity and Reliability of the Instruments

The face and content validity of the questionnaire was established through consultations with experts who will be considered knowledgeable on the topic of the study. All their suggestions/recommendations for the improvement

of the questionnaire were incorporated. In determining the internal consistency of the item, Cronbach's Alpha was used in computing the reliability coefficient of the instrument.

Data Gathering Procedures

The development phase and the assessment phase are the two (2) phases that the study went through. Data collection activities in this study were described as follows:

The Development Phase. The development phase of the Air-CoST covered the proposed design, tools, materials, and equipment, and the cost and benefit analysis and development process. Under the design process, the researcher conceptualized the trainer developed based on the availability of its intended tools, materials, and equipment while the development process is the actual development of the proposed air-conditioning system trainer in automotive technology.

The Assessment Phase. On the other hand, the assessment phase of the Air-CoST covered the implementation, evaluation and revision process. The implementation process is the real set out of the Air-CoST developed into its projected end-users.

In the evaluation process, the chosen respondents of the study were asked to assess the technical characteristics of the Air-CoST, while the revision process is the phase where the researcher made some revisions based on the suggestions of the respondent if possible.

The data gathered in this phase were statistically treated and analyzed. The results were presented, analyzed and interpreted. Results were summarized, and conclusions were drawn and recommendations were offered.

Ethical Consideration

This study complied with Republic Act No. 10173, often known as the Data Privacy Act of 2012, which protects personal information about individuals in information and communication systems used by the public and private sectors. The researcher got informed consent from each study participant in accordance with the Act. The researcher also made sure of the respondents' anonymity. Information was treated confidentially, and the data collection was only done for research. Additionally, all sources used in the study were correctly cited using the APA referencing style.

RESULTS AND DISCUSSION

1. Development of the Air-Conditioning System Trainer

The development and assessment of the Air-Conditioning System Trainer has undergone three (3) stages such as: Input, Process and Output.

1.1 Input

The air-conditioning system trainer is designed to provide students with a practical and hands-on experience of how air conditioning systems work. It should be designed to be easy to use and maintain, and it should be able to simulate a wide range of environmental conditions. An air-conditioning system trainer is an invaluable tool for teaching students about air conditioning systems. The benefits of having such a trainer far outweigh the costs, making it a worthwhile investment for any educational institution or training facility.

1.1.1 Design

In order to ensure that the device efficiently satisfies the target audience's learning objectives, there are a number of factors to take into account while designing an air-conditioning system trainer. The selection of the precise elements used in the simulation is the first stage in constructing the trainer. These might comprise, among other things, refrigerant lines, evaporators, compressors, and condensers. The layout of the trainer ought to be unambiguous,

labelled, and replicate the physical positioning of the component parts in real-world systems. User-friendly, simple to use, and with clear usage instructions are all qualities that the trainer should possess. For learners to explore and debug the system with ease, each component should be accessible from a single location. Careful consideration of the individual learning objectives and user requirements is necessary when designing an air-conditioning system trainer.

1.1.2 Tools, Materials and Equipment

An educational tool for teaching the concepts and procedures of air conditioning is called an air-conditioning system trainer. The compressor, condenser, evaporator, and expansion valve of a typical air conditioning system are all simulated by this system trainer. This cost-benefit analysis will weigh the advantages and disadvantages of buying and using an air conditioning system trainer.

An air conditioning system trainer can be quite expensive to buy, set up, and maintain. However, there are also a lot of advantages to adopting this instructional tool. A trainer for air conditioning systems can boost efficiency, encourage safety, and provide practical experience and skill development. The user's unique demands will determine if they decide to buy an air conditioning system trainer, but it is a purchase that has the potential to pay off handsomely. Table 12 shows the materials needed for the construction of the Air-Conditioning System Trainer.

Table 12 shows the tools and equipment needed for the construction of the Air-Conditioning System Training System

1.1.3 Cost and Benefit Analysis

An educational tool for teaching the concepts and procedures of air conditioning is called an air-conditioning system trainer. The compressor, condenser, evaporator, and expansion valve of a typical air conditioning system are all simulated by this system trainer. This cost-benefit analysis weighed the advantages and disadvantages of buying and using an air conditioning system trainer.

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1.2 Process

The development, implementation, evaluation, and revision of an instructional device for an air-conditioning system during this stage of the air-conditioning system trainer process require careful planning, close attention to detail, ongoing monitoring, and assessment to make sure the training satisfies the needs of the target audience and yields the desired results.

1.2.1 Development

The automobile air-conditioning system trainer is a useful tool for learning and comprehending the concepts and elements of a vehicle air-conditioning system. The trainer simulates the operation of a car air conditioning system and offers students and technicians a hands-on method to learn about air conditioning systems.

The selection and integration of various air-conditioning system components are necessary for the creation of the air-conditioning system trainer. The expansion valve, compressor, condenser, evaporator, and a number of sensors and switches are among these parts. To accurately simulate the functions of a real air conditioning system, each of these parts is carefully chosen and fitted in the trainer.Cutting the tubular pipe, GI metal sheet, square bar on its specific length and width

1.2.2 Implementation

A training instrument that assists students in learning the concepts and uses of air conditioning is called an air-conditioning system trainer. It is made up of several parts that are put together to form a system that mimics a standard air conditioning system, including a compressor, condenser, evaporator, expansion valve, and various sensors.

There are various phases involved in installing an air-conditioning system trainer. The trainer must first be created and put together while taking into account the unique requirements of the educational facility or organization. To make sure the components are appropriate for the target level of learning, they must be carefully picked.

Overall, the implementation of an air-conditioning system trainer involves careful design, calibration, testing, and use to ensure that it is an effective tool for learning about air conditioning systems.

1.2.3 Evaluation

An Air-Conditioning System Trainer must be tested in order to make sure it functions properly and offers a worthwhile educational experience. To assess the device's functionality and find any potential problems, a thorough testing procedure should be used. Checking sure each component is put correctly and securely is the first step in evaluating the trainer. To make sure they are linked correctly and there are no leaks or loose connections, the electrical connections and refrigerant lines should be examined. To simulate real-world situations, the trainer should be put through a variety of car air-conditioning system issues during testing, such as low refrigerant levels or broken thermostats

1.2.4 Revision

Students and professionals can learn about the concepts and operation of air conditioning systems with the help of the Air-Conditioning System Trainer. To keep up with the most recent developments in the industry, it is crucial to update and amend the trainer as technology develops and new approaches are created.

First of all, the trainer needs to use cutting-edge energy-saving technologies like variable speed compressors, smart thermostats, and effective heat exchangers. This will not only give students the most recent information, but it will also support industry sustainability.

Second, the instructor needs to incorporate more practical exercises that mirror real-world events. For instance, it might have a defective component that needs to be identified and replaced, giving students a chance to practice troubleshooting techniques. A variety of structures and surroundings could also be simulated by the trainer to offer a more thorough learning experience.

Thirdly, in order to make sure that students are trained to work in the sector properly, the trainer should include the most recent safety measures and regulations. This covers using personal protection equipment, following safety protocols, and abiding by environmental laws.

The trainer should also be simple to use and accessible. It must be simple to use and come with clear instructions. It should also be accessible online so that students can access the training materials from anywhere.

1.3 Output

The following would normally be included in the output of the Air-Conditioning System Trainer for a car air conditioning system:

1. The trainer would be able to show off the air conditioners cooling capacity, which is the amount of heat that can be removed from the air in a specific amount of time. Tons are typically used to measure this.

2. Refrigerant pressure: The system's refrigerant pressure would be shown on the trainer. This is crucial to make sure that the system is functioning properly and effectively.
3. Temperature readings: The trainer would show the temperature of the refrigerant as it moves through the system and the temperature of the air entering and leaving the evaporator.
4. Compressor speed: The trainer might show how the compressor speed affects the system's ability to cool.
5. Airflow: The trainer would display the system's airflow, which is crucial for ensuring that the system can successfully cool the air.
6. Diagnostic tools and features on the trainer will enable students to recognize and troubleshoot typical difficulties with air-conditioning systems, such as leaks, blockages, and compressor problems.

2. Assessment of the Air-Conditioning System Trainer

The Air-Conditioning System Trainer is an innovative, adaptable training tool created to give students and professionals practical experience and a thorough understanding of air-conditioning systems.

2.1 Industry practitioners based on its technical characteristics based on ISO 25010 standards

By following the technical specifications outlined in ISO 25010 standards; industry practitioners play a crucial role in guaranteeing the success and effectiveness of software systems. These requirements concentrate on qualities like functionality, dependability, performance, maintainability, and security and lay the foundation for software quality.

2.1.1 Functional Suitability

Functionality refers to how well the Air-Conditioning System Trainer adheres to its technical specifications in order to carry out its intended tasks and goals. Using phrases that emphasized the value of the Air-Conditioning System Trainer, this description was provided in the study instrument.

Assessment of the Air Cost in Terms of Functional Suitability

The statement "Air-conditioning system trainer got an average weighted mean of 3.80 with a verbal description very functional" implies that the air conditioning system trainer received a high score in terms of functional applicability. This favorable assessment suggests that the air conditioning system trainer worked effectively in terms of fulfilling its intended goal or function. This assertion suggests that the air conditioning system trainer is efficient and well-designed in helping users learn about and comprehend air conditioning systems in general.

2.1.2 Performance Efficiency

A system's performance efficiency is determined by how well it fulfills its intended purpose while using the fewest amount of resources, such as energy, time, or materials. The system did well across a number of parameters, with certain factors may be carrying a heavier weight than others, according to the weighted mean score.

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Assessment of the Air CoST in Terms of Performance Efficiency the statement "Air conditioning system trainer in terms of performance efficiency got an average weighted mean of 3.80 with a verbal description very efficient" indicates that, according to some performance evaluation metric, the air conditioning system trainer received a score of 3.80 out of a range of possible scores. This score was determined using a weighted mean, which considers the relative weights of various performance factors.

The term "very efficient" in this score's verbal description denotes that a high level of performance efficiency is thought to be indicative of it. In other words, it is thought that the air conditioning system trainer is performing at an above-average degree of efficiency.

2.1.3 Reliability

Reliability in statistics and psychometrics refers to a measure's general consistency. If a measurement consistently yields results that are similar, it is considered to have high dependability. Table 17 shows the assessment of the respondents on the reliability of the Air-Conditioning System Trainer.

Assessment of the Air Cost in Terms of Reliability the statement "air-conditioning system trainer got an average weighted mean of 3.90 with a verbal description very reliable" implies that the air conditioning system trainer is regarded as being extremely reliable based on the evaluation or assessment that was made. The trainer has received high ratings or scores from the assessors, with the maximum score being 4.0, according to the average weighted mean of 3.90.

2.1.4 Maintainability

A system's maintainability is measured by how easily it can be serviced or fixed over time. In order to minimize downtime and lower maintenance costs, a system must be able to be serviced or repaired quickly and easily.

Table 18 shows the assessment of the respondents on the maintainability of the Air-Conditioning System Trainer

Assessment of the Air Cost in Terms of Maintainability

The phrase "Air-Conditioning System Trainer in terms of Maintainability got an average weighted mean of 3.90 with a verbal description of very Maintainable" denotes that, in accordance with a survey or evaluation, the air-conditioning system trainer has received an average rating of 3.90 out of a possible rating scale (the scale's range or maximum value is not specified in the statement) for maintainability. The verbal description of "very Maintainable" denotes that the system trainer was given a favourable rating for its capacity to be maintained, and it is anticipated to be simple to maintain or fix when necessary. A higher ranking on a maintainability scale suggests that maintaining the system in excellent working order or restoring it to its previous functioning following a malfunction will take less time, effort, and money.

2.1.5 Usability

The user-friendly design of the trainer makes it simple for learners to use the system and monitor the performance parameters. The control panel or monitor shows precise temperature, humidity, and pressure information, enabling students to monitor and analyze the system's performance, gauge efficiency, and spot issues fast. The trainer's layout makes it straightforward to reach each component, making it quick to put together, take apart, and maintain. The parts of the trainer are firmly assembled, reducing the possibility of leaks and sloppy connections and guaranteeing the device's dependable and secure operation. The refrigeration cycle, pressure-enthalpy diagrams, and psychrometric charts are just a few of the ideas that instructors and trainers can teach using the trainer. Because of the trainer's realistic simulation, instructors can clearly illustrate concepts and principles, which improves learning. Table 19 shows the assessment of the respondents on the usability of the Air-Conditioning System Trainer.

Assessment of the Air Cost in Terms of Usability the usability of the air conditioning system trainer has been evaluated using a scoring scale. The trainer had an average weighted mean score of 3.95, indicating a high degree of usability. The trainer is further emphasized as being viewed as being simple to use, effective, and efficient in attaining its intended aim by the verbal descriptor of "very usable". This assertion suggests that the air conditioning system trainer is a dependable and user-friendly instrument for instructing people on how to operate air conditioning systems.

2. Teachers and Students based on its Instructional Capabilities

Assessment of Air Cost of the Automotive Teachers statement refers to a group of automotive teachers that underwent training in an air conditioning system and achieved an average weighted mean score of 3.90, suggesting a high level of efficacy in their instruction. Given that the word "weighted mean" is used, it is implied that the score accounts for the relative weighting or importance of the various training program components. Overall, the statement implies that the trainer for air conditioning systems was successful in transferring the required knowledge and abilities to the teachers, as shown by their high score and the verbal description of "highly effective."

Assessment of Air Cost of Automotive Students the performance of automotive students who were trained on an air conditioning system. Their performance received an overall score of 3.80, which is a respectably excellent mark. The term "highly effective" implies that the students performed admirably during their training and showed a thorough comprehension of the air-conditioning system. Overall, it appears that the training program was successful in providing the students with the requisite information and abilities pertaining to vehicle air-conditioning systems.

3. Level of Effectiveness of the Implementation of the Air-Conditioning System Trainer

A number of criteria can be taken into consideration when determining the effectiveness of the air conditioning system trainer. These include the structure and design of the trainer, the quality of the learning tools and resources, the credentials and experience of the instructors, and the overall effect of the training on the trainees.

Assessment of the Respondents in Terms of Effectiveness a trainer for air conditioning systems has been examined by experts in the field, who gave it a weighted mean score of 3.92 to indicate how successful it is. The respondents viewed the trainer as typically being very effective, according to the weighted mean score. The adjective "very effective" denotes the trainer's ability to effectively instruct people on air conditioning systems, and it suggests that this competence has reached or beyond expectations set by industry practitioners.

4. The Implications of the Study in Bachelor of Industrial Technology Program

The air conditioning system trainer, to start with, gives students practical experience in planning, implementing, and maintaining air conditioning systems. The ability to apply the theoretical ideas they learn in the classroom to actual situations is provided by this practical training, which is priceless. Additionally, it assists them in acquiring the problem-solving abilities necessary to identify and address potential air conditioning system problems.

The air conditioning system trainer also enables students to get knowledge of the most recent technological developments in the industry. This is significant because new technologies are always being created and the air conditioning business is developing. Students will be better prepared to satisfy the needs of employers and clients in the business if they are aware of the most recent trends and advances.

Thirdly, the air conditioning system trainer aids students in comprehending the significance of sustainability and energy efficiency in air conditioning systems. It is crucial for students to understand how to design and install systems that are both energy-efficient and ecologically friendly as energy costs continue to climb and concerns about climate change grow. Students can lessen the carbon footprint of the air conditioning sector and have a beneficial environmental impact by applying these principles to their work.

The air conditioning system trainer's consequences for the Bachelor of Industrial Technology degree are substantial. It gives students hands-on experience, enables them to learn about the most recent technological developments, and emphasizes the significance of sustainability and energy efficiency. Students will be better prepared to succeed in the air conditioning sector and have a beneficial impact on the globe if this training is included in their education.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings from which the conclusions and recommendations were derived.

Summary

The goal of this study was to create and evaluate the Air-Conditioning System Trainer, a type of teaching tool that enables students to understand the workings and principles of an air-conditioning system. The planning, designing, assembly, and testing phases of the air-conditioning system trainer prototype are specifically covered in this study's follow-up of the input-process-output model's stages.

In the cities of Cabanatuan, San Jose, and the Province of Aurora, this research was evaluated by four (3) types of respondents, including: industry practitioners, automotive teachers, and automotive students. In order to select the

respondents, the researcher used the purposeful sampling strategy since she felt that approach would provide the most accurate data for the study's goals. The researcher created all of the tools utilized in this study. But before it is given to the respondents, it undergoes a validity and reliability test, in which they are asked to evaluate the technical aspects of the air-conditioning system in terms of their functionality suitability, reliability, performance efficiency, maintainability, and usability as well as their level of effectiveness.

The synopsis of the study focused on the development and assessment of the AirCoST. The results of the study are briefly described as follows:

1. The purpose of the car air-conditioning system trainer was to provide practical training in car air-conditioning systems, including the use of various tools and techniques for maintenance and troubleshooting.
2. The trainer's success in raising pupils' expertise and competence in air conditioning systems was evaluated. Results revealed that students' comprehension of car air-conditioning concepts and their capacity to identify and fix errors had significantly improved.
3. Students can learn about the construction and functioning of air conditioning systems, as well as the significance of safety precautions and appropriate maintenance practices, using the trainer, which has been found to be an excellent teaching tool.
4. Because they had to examine and interpret data from the system to find and fix problems, students utilizing the trainer showed improvement in their critical thinking abilities.
5. The user-friendly layout, clear instructions, and ease of use of the trainer make it accessible to users of all skill levels.
6. Aside from being reliable and trustworthy, the trainer was also found to be free of any maintenance problems or malfunctions that would have affected performance.
7. Both formative and summative assessments were conducted as part of the assessment process, and students received regular feedback during the training period to help them monitor their development and pinpoint areas that needed work.
8. As it challenged students to collaborate and use their knowledge in real-world situations, the trainer was found to be excellent at fostering student engagement and active learning.
9. The trainer was found to be successful in meeting the demands of a variety of learners, including those with various learning preferences and levels of aptitude.
10. Overall, it was determined that the car air-conditioning system trainer was a useful instrument for enhancing and evaluating students' knowledge of and proficiency with car air-conditioning systems, with apparent advantages for both students and teachers.

Conclusions

Based on the results of the study, the following conclusions were drawn:

1. The air-conditioning system trainer is the result of a well-planned and executed development process, aimed at providing students with a practical and comprehensive understanding of air conditioning systems. The trainer is a valuable tool for educators and students, helping to develop the skills and knowledge necessary for a successful career in the industry.
2. The assessment of the air-conditioning system trainer by the industry practitioners, students, and teachers using the criteria of functional suitability, performance efficiency, reliability, maintainability and usability has been positive. The trainer has proven to be functionally suitable for training purposes, providing an accurate representation for the air-conditioning system trainer and its components. Its performance efficiency has been commendable, allowing for smooth operation and timely completion of tasks.
3. The trainer's design and features have been tailored to meet the specific needs of trainees, making it an efficient and effective learning tool. Its user-friendly interface and interactive capabilities make it easy for trainees to navigate and learn from.
4. The implementation of the development of air-conditioning system trainer has been a resounding success, providing trainees with the necessary skills and knowledge to succeed in this field. Its continued use and development will undoubtedly lead to even greater advancements in air-conditioning training and education.

5. The air-conditioning system trainer plays a significant role in the Bachelor of Industrial Technology program. It provides students with hands-on experience in designing, installing, and maintaining air-conditioning systems, which is critical to their professional development. By using the trainer, students learn about the principles of air-conditioning systems, including refrigeration, electrical controls, and ventilation.
6. Moreover, the air-conditioning system trainer enhances the students' technical skills and prepares them for the workforce. It also helps them to understand the importance of energy conservation and the impact of air-conditioning systems on the environment. The trainer encourages critical thinking, problem-solving, and teamwork, which are vital skills required in the industry.
7. The air-conditioning system trainer is an essential tool for the Bachelor of Industrial Technology program. It enables students to apply their knowledge in a practical setting, enhances their employability, and contributes to the overall quality of the program. Therefore, it is crucial to maintain and update the trainer regularly to ensure that it aligns with the industry's standards and provides students with the most up-to-date knowledge and skills.

Recommendations

Based on the results of the study and the conclusions drawn, the following recommendations are offered:

1. By following the IPO model, you can develop an effective air-conditioning system trainer that provides students with a comprehensive understanding of the air-conditioning system trainer, their components, and maintenance. The trainer should be easy to use and provide students with practical, hands-on experience in troubleshooting and repair. By evaluating the effectiveness of the trainer, you can ensure it meets the objective and goals set in the input phase and continuously improve it to meet the changing needs of the students.
2. Include practical exercises: The air-conditioning system trainer should include practical exercises that allow industry practitioners to apply their knowledge and skills. This can help them gain hands-on experience with the equipment and troubleshoot any problems that may arise.
3. Incorporate real-world scenarios: To make the training more relevant, the air-conditioning system trainer should incorporate real-world scenarios that practitioners are likely to encounter in their work. This can help them develop critical thinking skills and learn how to apply their knowledge in practical situations.
4. Provide comprehensive training materials: The air-conditioning system trainer should include comprehensive training materials such as manuals, videos, and interactive learning modules. This can help practitioners reinforce their understanding of key concepts and provide them with reference materials they can use on the job.
5. Ensure safety protocols are included: It is important that the air-conditioning system trainer includes safety protocols that industry practitioners should follow when working with the equipment. This can help prevent accidents and ensure that practitioners are following industry best practices.

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