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Enhancing Basic Electricity Education Through Computer Based Training in The Avionics Department

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Abstract — Basic electricity is a vital subject in technical education, laying the foundation of areas such as electrical engineering, electronic engineering, avionics technology, and telecommunications. The research investigates the use of computer-based training (CBT) in technical education. Traditionally, this topic has been taught through textbooks, lectures, and experiments, but CBT provides students with a transforming learning experience. The research project explores the benefits of simulation-based training and its effectiveness across different learning styles, providing a safe and cost-effective learning environment. The study was conducted at the Avionics Department of WCC College of Aviation Technology, targeting second-year avionics students, faculty, and instructors. Before the development of the project, the research first involved interviews with students and faculty to understand the impact of CBT compared to traditional methods, content adaptation, implementation challenges, and effects on self-paced learning and problem-solving skills. The developed CBT application, named "BEE-CBT," was tested for reliability, usability, and compliance with standards, ensuring its stability under various conditions. The application was designed as a closed system to prevent user modifications after distribution. During the piloted test, students engaged with the application through modules, quizzes, and simulators. The feedback received from students and instructors was positive, with valuable comments and suggestions. It also highlights the convenience and portability of the application, making it popular among students and faculty. After completing the application project, the researchers used ISO25010 software quality standards to evaluate the application's strengths, weaknesses, and potential areas of improvement, using statistical tools for data analysis. In general, the results showed that the BEE-CBT application effectively delivered basic electrical lessons in a user-friendly and interactive manner. Students and instructors responded positively to the application, praising its convenience and portability. Hence, based on the results, the CBT software application for Avionics Department achieved excellent performance in various aspects.

Keywords — Basic Electricity Education, Engineering And Computer-Based Training, Avionics Department

I. Introduction

In the field of technical education, basic electricity is a basic subject that forms the basis of various academic disciplines such as electrical engineering, electronic engineering, avionics technology and telecommunications. Traditionally, the fundamentals of electricity have been taught through textbooks, lectures, and hands-on experiments. However, as technology has advanced, the integration of computer-based training (CBT) has revolutionized the way students learn and engage in this subject.

One of the most rapidly increasing fields of training is through simulations and simulators. "Simulation training was used as a tool to teach trainees about the skills needed in the real world. It provides a lifelike point-of-care learning experience and has been widely applied in fields such as aviation, the military, and health care" (Martinali, 2022). In addition to reading textbooks and listening to lectures, trainees practiced practical information and skills through physical activities. This type of training is effective because it accommodates multiple learning styles favored by different types of learners. Not everyone learns by sight or hearing. Simulation-based training is a highly efficient and effective way to teach essential skills to your students. It is an ideal tool for trainers to gauge whether trainees are skill-based, decision-ready and competent against the backdrop of simulated real-world situations.

According to Ratu and Erfan (2017). The objective of the Samawah University study was to examine the effect of Every Circuit Simulator on student motivation and aptitude for electrical circuit analysis. In this quasi-experimental study, the control group design was the same before and after testing. A learning motivation questionnaire and an analysis test sheet for electrical circuits are tools for this research. The results showed that the students' motivation in the experimental group was higher than that in the control group.

CBT employs multimedia elements and interactive exercises that promote active learning and engagement. This approach enhances students' retention of Basic Electricity concepts by stimulating multiple senses and catering to different learning styles. The visually rich and immersive nature of CBT content helps create a more engaging learning environment, resulting in improved knowledge retention. Basic Electricity involves working with potentially dangerous electrical circuits. CBT provides a safe learning environment for students, allowing them to practice and experiment with circuits virtually, minimizing the risk of electrical accidents. Students can gain hands-on experience without the fear of damaging equipment or causing harm to themselves.

The application of computer-based training in Basic Electricity education brings numerous advantages to both educators and learners. By leveraging interactive multimedia elements, flexibility, and real-time assessments, CBT offers an enhanced learning experience that promotes better comprehension, engagement, and retention of Basic Electricity concepts. As technology

continues to evolve, integrating CBT into educational institutions can equip students with the knowledge and skills needed to excel in the field of electricity and related disciplines.

Implementing CBT in Basic Electricity education can be a cost-effective approach compared to traditional methods. With CBT, educational institutions can reduce expenses on physical equipment, maintenance, and consumables. Moreover, it eliminates the need for specialized training facilities, enabling schools and colleges to allocate resources efficiently. Educational institutions should integrate CBT modules seamlessly into the Basic Electricity curriculum. This involves identifying the appropriate topics and aligning them with CBT content. By incorporating CBT as a core component of the curriculum, students will have consistent exposure to interactive learning experiences throughout their Basic Electricity education.

Collaborating with industry experts and professionals in the field of electricity can ensure that the CBT content remains up-to-date and relevant. Industry partnerships can provide valuable insights into emerging technologies, practical applications, and real-world scenarios, enabling students to bridge the gap between theory and practice effectively. CBT platforms should be designed to allow customization and adaptation according to the specific needs of students and educational institutions. This may involve providing different levels of difficulty, personalized learning paths, and adaptive feedback mechanisms. By tailoring the CBT experience to individual learners, their engagement and motivation can be maximized.

Establishing a feedback loop with students, teachers, and stakeholders is essential for continuous improvement of the CBT program. Regular assessments, surveys, and focus groups can provide valuable insights into the effectiveness of the CBT content, user experience, and overall learning outcomes. This feedback should be used to refine and enhance the CBT modules over time. Teachers play a crucial role in facilitating CBT in the classroom. Providing professional development opportunities for teachers to familiarize themselves with CBT tools, techniques, and best practices can ensure effective implementation. Training programs can equip teachers with the skills to integrate CBT seamlessly into their instructional strategies, enabling them to support and guide students effectively.

By implementing these innovative interventions and strategies, Basic Electricity education can be significantly enhanced through computer-based training. Through collaboration, customization, continuous improvement, and effective monitoring, CBT can revolutionize the way students learn and engage with Basic Electricity concepts, fostering a deeper understanding and preparing them for success in their future careers.

Literature Review

According to Jaakkola and Veerman (2020), In the context of learning about electric circuits in secondary school, this study compared learning in a simulation environment with a single representation to learning with concreteness fading. To combine the benefits of each representation and to encourage transfer, concreteness fading, an educational technique where

representations shift from concrete to more abstract during a learning sequence, has been proposed. However, the empirical evidence is not conclusive. One explanation could be because, as the conceptualization of concreteness fading in this work demonstrates, defining "concrete" and "abstract" for the sake of concreteness fading is less simple in practice than in theory. The findings revealed no differences in content coverage or overall learning time between conditions, however, the fading condition's learning time was briefly extended by the transition between representations. Analysis of the learning found no differences between conditions on circuits with characteristics resembling those of the simulation environment, however, the use of a single representation improved the transfer of information to actual circuits. The results are discussed from the angles of concreteness fading and alternate learning environment conceptualizations. One of these is that computer simulations can combine concrete and abstract elements into a single representation, which may be simpler (and more efficient) in educational settings than multiple representations. This result comes from the difficulty in positioning computer simulations within concrete-abstract dimensions.

According to Ratu and Erfan (2017), The study from Samawa University intends to look at the impact of Every Circuit Simulator on students' desire to learn and aptitude for electrical circuit analysis. In this quasi-experimental study, the control group design was the same before and after the tests. Questionnaires about learning motivation and an analytical test sheet for electric circuits are the instruments employed in this study. The experimental group had higher student motivation than the control group, according to the results.

According to Itagi and Deshpande (2015), Electronics and telecommunications play a significant part in practically every aspect of our lives nowadays. Every aspect of our existence has been affected by it. We can see, hear, and communicate over great distances thanks to electronics and telecommunications technology, which also helps us do tasks more quickly. It primarily focuses on communication technologies coupled with fundamental electronic parts, circuit design, and system design. The most well-known circuit simulators now, such as MATLAB, TINA, NCTUns, and CADENCE, are briefly discussed in this work. Computer circuit simulators are programs that aid in the analysis of electronic circuits and assist in predicting a large portion of their performance without physically building the circuits themselves from hardware components. It performs system analysis quickly, accurately, and with user-friendly technology. By including the students in the learning process, computer simulation, which is simply a virtual technique of simulating the behavior of a circuit, engages the students. Students can learn more about computer hardware and software at the same time by substituting a simulation of a circuit's operation for a monochromatic classroom lesson on how a circuit works. The phenomenal expansion of simulators has brought about a variety of innovative e-learning technologies and will be a huge help to engineers in the years to come.

According to Antipolo and Lopez (2021), Many universities were closed around the world because of the COVID-19 pandemic. Given this predicament, teaching technical and practical

courses would undoubtedly be very difficult because face-to-face instruction is not allowed. For example, the study of electric circuits, which calls for some technical ability, seems to be challenging for both students of electronics technology and the instructors teaching such courses. The researchers opted to undertake a study using a mobile simulation tool, the EveryCircuit.simulation program, after observing this issue with modular learning. This open-access simulation program is made to cover fundamental knowledge of circuit types and hands-on activities with electric circuits.

According to Celorico (2017), This experimental study sought to determine how video simulation affected Grade 10 students' performance in physics throughout the academic year 2016–2017. The lecture-discussion method was presented to the same number of students (20) as the video simulation method. A 50-item teacher-made test was used to gauge students' performance in Physics. The assignment of which group was placed in the video simulation group, or the lecture-discussion group was done at random. Kinematics, forces, dynamics, and friction were the subjects discussed. Using t-tests for dependent samples and independent samples, performance test data were examined. Findings showed that students exposed to the video simulation teaching approach considerably outperformed those exposed to the lecture-discussion method in post-intervention tests. This suggests that using video simulations is more efficient than using lectures and group discussions.

According to Estipular and Roleda (2018), It is commonly acknowledged that experiential learning, especially in elementary education, is useful in science. However, it is still usual in the Philippines for science to be taught exclusively through traditional lectures. There are not enough lab supplies, especially at government schools. Interactive simulation in the teaching of high school science is one technique to overcome this. This action research project uses interactive simulation to enhance science instruction for Grade 9 students. The PDSA cycle served as the framework for the initial round. In a significant Philippine metropolis, a public high school served as the research setting. Participants in the 4-week course included two complete classes who received education in fundamental physics. There were eight interactive simulations employed, encompassing motion, forces, and mechanical energy. The pupils' conceptual grasp of these issues has significantly improved, according to their pre-and post-test results. Moreover, as each cycle stage is completed, the teacher's experiences were also provided.

According to Cellier, et al. (2007), the capacity to model and simulate electronic circuits within Modelica, an object-oriented general-purpose environment for the modeling of physical systems, has recently been the focus of three separate studies at three different institutions. No domain-specific knowledge is hard-coded into the Modelica software to make it broadly applicable. Modelica is only capable of comprehending mathematics, not physics. Consequently, the model must incorporate all domain-specific knowledge. It is now possible to create a full-featured electronic circuit simulator in Modelica without incurring unacceptable compromises on the run-time performance of the resulting simulation code because of recent developments in

symbolic algorithms and software technologies. Gains from the process include a greatly increased ease of use and enhanced transparency of the models being implemented.

According to Nuanmeesri & Poomhiran (2019), five experts assessed the usefulness of employing virtual reality media for STEM electrical circuit activities, using the Index of Item-Objective Congruence (IOC), where the IOC for each criterion was 0.8 or above. According to the results, its arithmetic mean was 4.67 with a standard deviation of 0.47, indicating that it was highly effective at teaching electrical circuits. It was determined after assessing its efficacy in the domain of information technology adoption that the arithmetic mean for these criteria is 4.64 with a standard deviation of 0.48. This shows that the subjects were in favor of using virtual reality media to teach STEM courses at the highest level.

According to Litovski, et al, (2005), because an ideal switch is a nonlinear component of any circuit, in a general-purpose time-domain circuit simulation program, we created a model for the perfect switch that may be used. The switch is thought of as a component of a circuit and used in a manner like that of any other circuit element. One of the model's crucial characteristics is that it handles real-world circumstances, like controlling the Dirac pulse that occurs when genuine circuits are being switched. Here, a series of examples are given to illustrate the model's efficacy and adaptability, in our opinion.

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II. Methodology

This application focuses on simulation training for professors and students of Department of Avionics, WCC College of Aviation Technology, Binalonan, Pangasinan. This application includes a basic electrical module, a basic electrical quiz, and a simple electrical simulator that students and instructors can use during lab and classroom discussions.

A basic electrical simulator can show you if your schematic or circuit is working, but the application does not determine why your schematic design is not working. The application also includes basic electrical modules and tests created by researchers under the guidance of research advisers. As long as the user/student uses her Android device, the researcher application has unlimited storage. The application does not send any data to the remote server and all student/user progress test results are saved on your device and not on the remote server. The Basic Electricity CBT is accurate because the researcher already covers basic electrical subjects and the researcher is guided by a research adviser.

Additionally, this survey is primarily for Android users only. Accessible with or without internet. This application can only be accessed by those who have mobile phones with Android or newer operating systems. However, if the user makes many connections in the chart, the user's phone does not have the freedom to use the space and screen allotted to the phone and the processing power of the phone. New or revised information on topics that researchers have included in modules and tests cannot be changed.

The researchers decided to set up a research environment for the "Avionics Fundamentals Electricity Simulator" department at the WCC Aviation Technology University Binalonan, especially for students of the Avionics Department taking basic electrical courses and laboratories. The researchers chose these settings because they are convenient for students to use in classroom discussions and in the lab.

Researchers conducted the evaluation process by managing data and responses, and collecting and analyzing results to the avionics department. An evaluation questionnaire is completed by the trainer. The survey included both open-ended questions and rating scales. Questions are short, clear, unbiased, and easy to understand.

Researchers created a questionnaire-like sample that was be validated by the professor of the basic electricity subject, then the questionnaire checklist was be distributed. Due to the

advantages of the survey method, the researchers specifically targeted second-year avionics students in their study. The researcher's goal in this study was to create a software project that includes simulators, tests, and brief explanations on various topics. Because the main problem with avionics is the trial and error of activities that use many components that don't physically exist. Researchers believe that this method is the most suitable for selecting samples for study. After respondents completed the questionnaire, researchers collected and counted the data for interpretation.

The researchers evaluate the application by having some students test the real application. Next, complete a survey conducted by the researcher to ascertain the student's overall experience and satisfaction with the application. Once the study is complete, researchers will analyze the results. The Basic Electricity Education computer-based training (BEE-CBT) for WCC Aviation Technology College at WCC Binalonan, specifically for the avionics department, will be introduced by researchers and will ask some students to try out the simulations under the supervision of researchers. Advisers answer participants' questions honestly and transparently. The participants are students of the Department of Avionics who have completed basic electrical engineering courses in their first year. Data is collected by researchers and is kept confidential only for testing and evaluation of simulators and applications.

A waterfall model is created for the project development of this work. This model is commonly used to create activity breakdowns in a linear and sequential approach. This model consists of problem analysis, where researchers analyze various problems within a particular organization. Software systems and applications suitable for the given problem are then designed. After design and adaptation, the project is developed and tested with appropriate code, images and simulator content. It is also necessary to check and troubleshoot the application to avoid unnecessary problems and errors that may arise. Trial and error is performed only when necessary. Finally, researchers will evaluate the project to determine if it is useful.

A basic electrical system simulator for avionics technology will be an application for courses and labs used by students and professors in basic electrical courses and labs. It helps students and professors teach and understand basic electrical subjects. This application can be run on his android device with his 3 main parts: basic electricity module, basic electricity quiz and simulator. The basic electrical system gives the student or professor the freedom to choose which modules or lessons to use in their application.

The system will first be tested by researchers and developers who will help them create applications. Finally, researchers randomly select avionics students who are taking a basic electrical engineering course and students who are already taking a basic electrical engineering course.

III. Results and Discussion

Development Phase Analysis

Software specifications

The Simulator for Basic Electricity (SBE) is a learning application that contains information about the basic electricity module, basic electricity quizzes, and simulator. The application can only be accessed using an android device; the researchers highly recommend using an android tablet with the minimum specifications of a snapdragon processor or higher, at least 4GB RAM, and at least 32GB of storage.

Program Specifications

Purpose. The purpose of the application (SBE) is to provide a computer-based training and simulator to students in making their circuits and learning basic electrical hands-on.

Scope. The application will be utilized by WCC ATC professors and students who are studying basic electrical and AC/DC subjects. It covers a variety of topics, including Boolean Algebra, Capacitors, Inductance, Logic Gates, OHM'S Law, Resistors, and Time Constant. Basic information regarding Basic Electrical is provided by the application. By using the offered simulator to put what they have learned in the application into practice, they are given quizzes that will evaluate their acquired knowledge.

Functional Requirements:

The Application will include the following features and functionality:

Modules. The Application will provide modules like Boolean Algebra, Capacitor, Inductance, Logic Gates, OHM'S Law, Resistors, and Time Constant. **Quiz**. The application will include quizzes as an assessment tool to evaluate and assess the user's understanding of the material covered in the modules.

Simulator. The Application will include a simulator to create and design to utilize what they have learned in the basic electrical module.

TECHNICAL ANALYSIS

The Secured and Enhanced Intercommunication System (SEICOMS) is a distributed software system designed to provide reliable and secured communication between multiple entities, such as users and devices. In this part it provides a detailed description of the technical requirements and architecture of the system and outlines the system's objectives, features, and technical data.

Technical Design

The SBE application, or Simulator for Basic Electrical, is a closed application. It has three different parts: The basic electrical module, basic electrical quizzes, and the simulator. This Application will also show the different features, the process of the program, and how it works.

Figure 1. Start page

Figure 1 shows the title page of the application. The start button, settings button, developers button, exit button, and the app's name. The start button will also take the user to the main page.

Figure 2. Menu Page

Figure 2 presents the menu page of the application which shows three choices the users can pick from: Basic Electrical Module menu page, Basic Electrical Quizzes menu page, and Simulator menu page. Once you click the select button you will be taken to the module page for that topic on the main page.

Figure 3. Basic Electrical module

Figure 3 shows the page for Basic Electrical Module. The Basic Electrical Module's lessons and sub-lessons are all shown on this page. When a user clicks on a lesson, you are redirected to that lesson's page. The user can return to the home page and choose a different topic by using the back button on this page, which is also included.

Figure 4. Basic Electrical lesson

Figure 4 displays the lesson's name, a brief introduction, and the lesson. The user can return to the home page and choose a different topic by using the back button on this page, which is also included.

Figure 5. Basic Electrical Quizzes Menu

Figure 5 shows the page for Basic Electrical Quizzes Menu. Depending on the lesson the user selects, this page offers various quizzes. A back button is also present on this page to assist users in returning to the home page

Figure 6. Basic Electrical Quizzes

Figure 6 shows the page for Basic Electrical Quiz. All of the Basic Electrical quizzes are shown on this page. Specifically, when a user clicks on a specific quiz, the user will be redirected to that quiz page. Moreover, the user can return to the home page and choose a different topic by using the back button on this page, which is also included.

Figure 7. Basic Electrical Quiz

Figure 7 shows the page for the Basic Electrical Quiz. The user must finish the quiz before proceeding with another quiz or have the chance to try the quiz again. The user can return to the home page and choose a different topic by using the back button on this page, which is also present on this page.

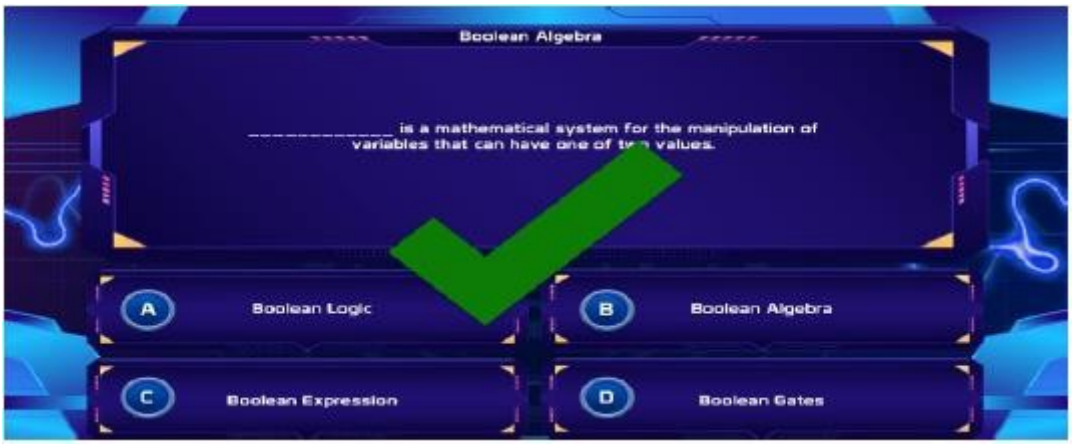

Figure 8. Basic Electrical Quiz

Figure 8 shows the page for the Basic Electrical Quiz. A checkmark will appear if the user's answer is correct.

Figure 9. Basic Electrical Quiz

Figure 9 shows the page for the Basic Electrical Quiz. A cross will appear if the user's answer is incorrect.

Figure 10. Basic Electrical Quiz Result

Figure 10 shows the page for the Basic Electrical Quiz Result. On this page, the result or final score will be shown. Additionally, a try again button is there for the user to retake the quiz, and a back button to exit the quiz. Once again, the user can return to the home page and choose a different quiz by using the back button on this page, which is also present on this page.

System Design

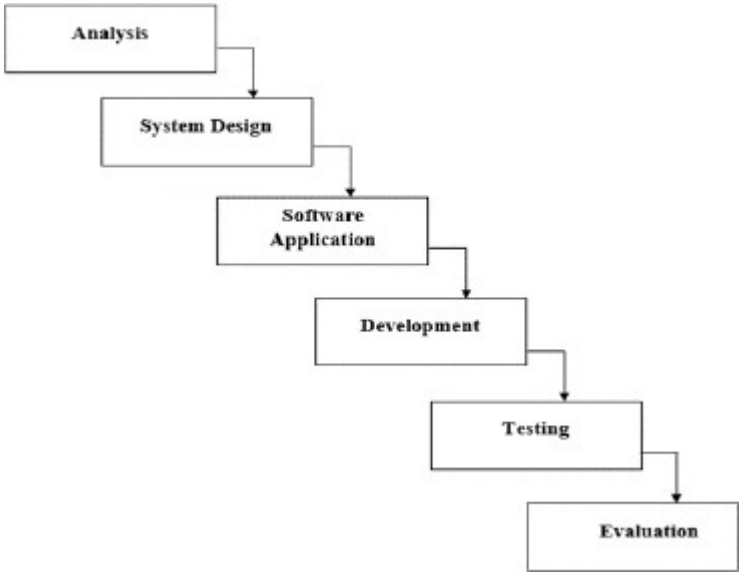

Figure 11. Waterfall method

The Waterfall software methodology introduced by Dr. Winston Royce is a linear and sequential approach to software development. This model has been popular especially for software projects because it shows the sequence of projects from beginning to end. In this approach, the software development process is divided into distinct phases, and each phase must be completed before the next one can begin. The phases in a typical waterfall model are the following:

1. Requirements gathering and analysis: In this phase, the requirements for the software are identified and documented.

2. System Design: The software design is created based on the requirements gathered in the previous phase.

3. Software Application: The actual coding and development of the software take place in this phase.

4. Development: The software is tested to ensure that it meets the specified requirements and works as intended.

5. Testing/Deployment: The software is deployed to the production environment.

6. Maintenance: The software is maintained and updated to ensure that it continues to function properly.

Object Modeling

Data Flow Diagram

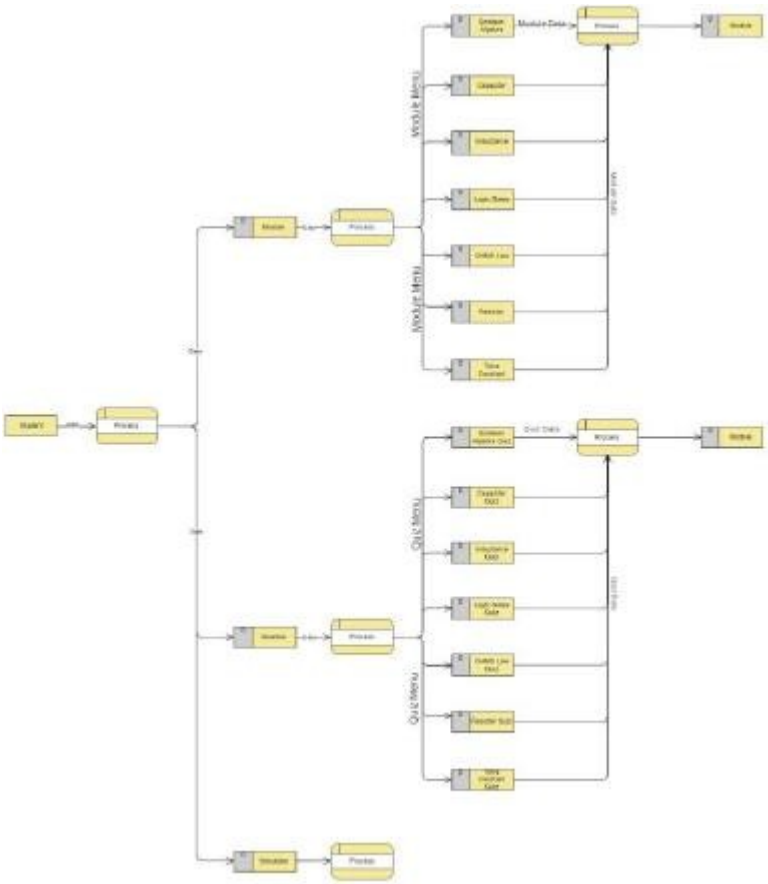

Figure 12- Data Flow Diagram

Figure 12 illustrates the flow of the application. Pushing the start button on the landing page/ main page, will take the user deeper into the app making you choose among 3 choices (Modules, Quizzes, and the Simulator).

Choosing the Module option opens a new page where the user is given a choice to choose what specific topic to open. Selecting a topic will bring the user to the module's slides. At the end of the module, the user has a choice to go through the modules again, or select a new module.

Upon choosing the Quizzes option, the user is brought to a new page where the user is to pick a topic of choice. Choosing a specific topic will open a page where there are no buttons back to the main menu or back to the selection of quizzes. Once opened, the user must complete the quiz. Upon completing the quiz, the user is given a score, a choice to try again or to go back to the quiz selection page.

The final option is the Simulator. Choosing this option brings the user to a blank page with only a grid, and a short list of components. Users can drag and drop these components and create simple circuits. There is also a save button and an exit button that brings the user back to the selection of Modules, Quizzes and the Simulator.

System Flowchart

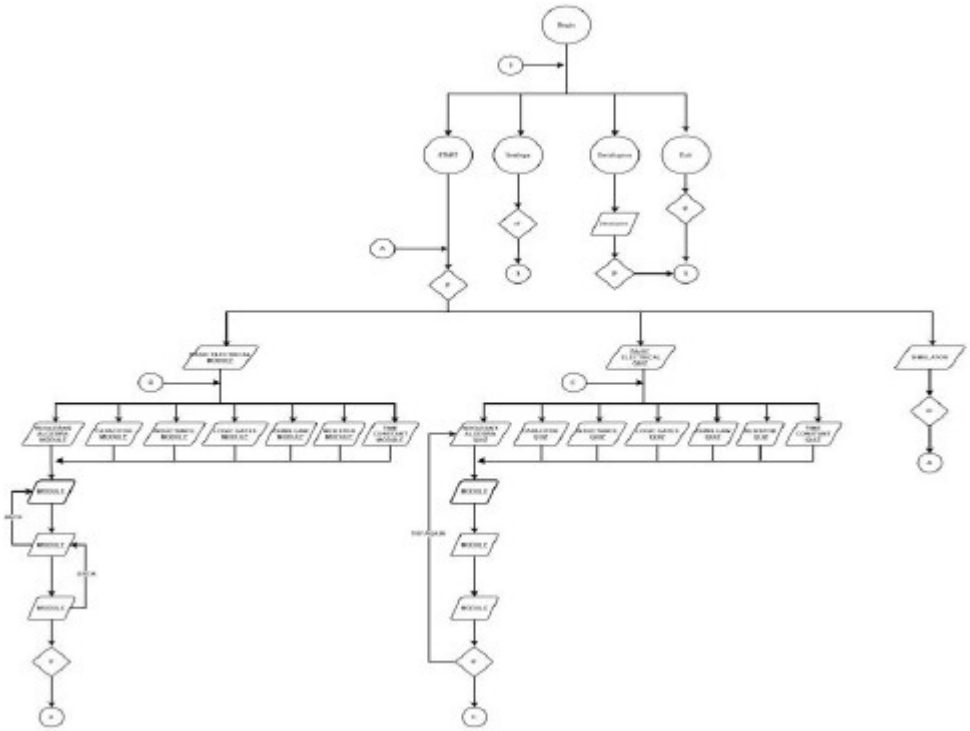

Figure 13 - Flow Chart

Figure 13, illustrates the flow chart of the overall system of the SBE Application with the user's possible options and the system's reaction to the user/s choice. First, to start the system a

start selection will show upon showing a start page of the system. From there, the user will have four choices: First, the settings menu where the user has the freedom to turn on and off the music. Second, the users will see the developers who made the application. Third, is the exit button that eventually ends the application. Lastly, the start is where the user can access the Modules, Quizzes, and Simulator. The SBE application has modules that the user can utilize during classes or even in laboratories. The modules cover a variety of topics including, Booleans Algebra, Capacitors, Inductance, Logic gates, OHMS Law, Resistors, and Time constant. This application also offers different sets of quizzes in-line with the modules included in the modules.

Use Case Diagram

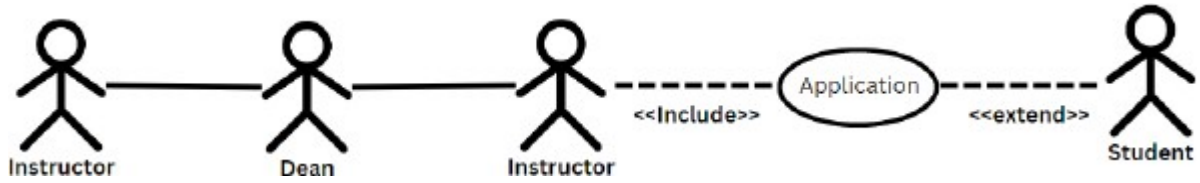

Figure 14 - Case Diagram

The Diagram illustrates the overall process of constructing the modules and quizzes before applying this information in the SBE application and disseminating it to the students. The Diagram is composed of two components: The elements and the action. The elements shown in the diagram are the Dean, the Instructor, and the Students. While the action is the part where the instructor disseminates the application to the students. This application has a five-step process which starts with the Instructor. The instructor will make the modules. Later on, passed to the Dean for his approval of the modules. Subsequently, the Dean will once the topics are approved. The instructor will then input the approved information in the SBE application. Lastly, the SBE application will be given to the Students.

Data Design

Data Dictionary

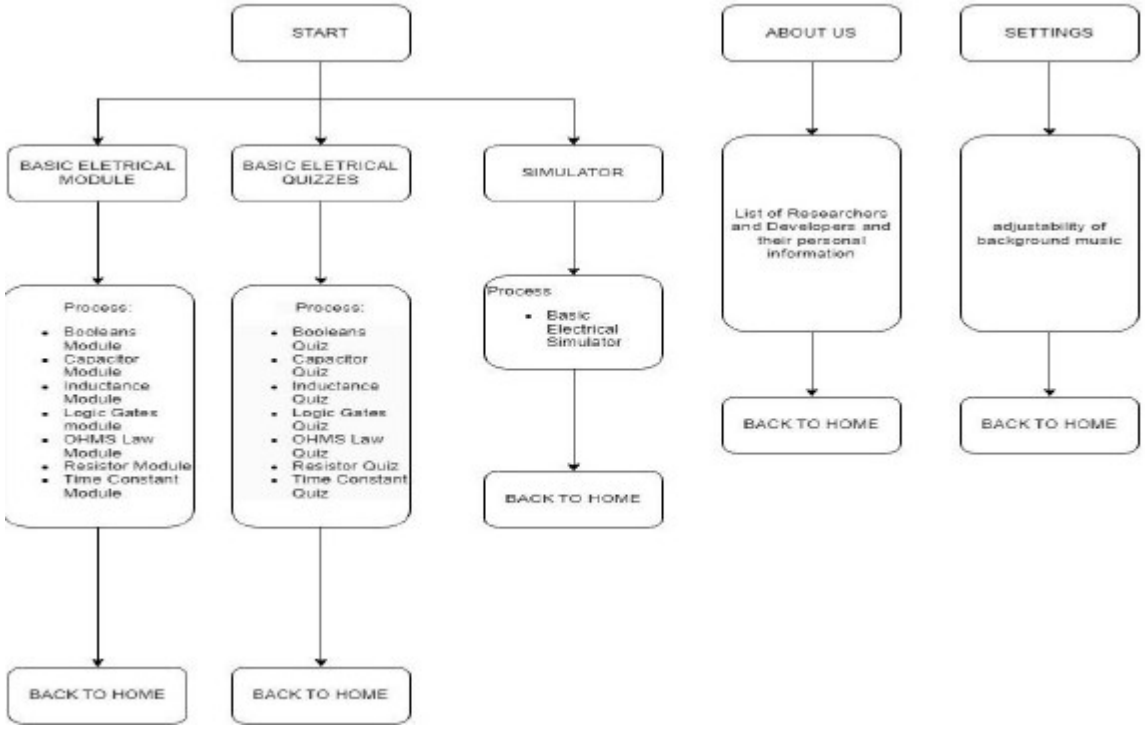

Figure 15. System Block Diagram

Figure 15 shows the System Block Diagram. The project system has three parts which are Start, About us, and Settings of the application. The start contains the basic electrical module, basic electrical quizzes, and a simulator. A short quiz is also provided in the application per module as well. The simulator consists of the module included in the application and it is user-friendly. The about us contains all information about the developer and settings help adjust the background music. The users cannot click back to home in quizzes and the users will have the option to either go back to all modules or back to the main page.

Security Design

The SBE application does not need personal information. Additionally, there is no need to input the User ID and passwords from the users to open the application. With this, the personal information of the user will not be compromised in using the SBE application. Overall, the security of the SBE application prioritizes the protection of the content of the application and the personal information of the user in using the application itself.

Final Output Perspective

VERIFICATION, VALIDATION, AND TESTING

Software applications needed a lot of different platforms and devices in order to perform the program smoothly. Different testing procedures are needed to ensure and to fully assess if the application reaches the standard and guidelines that will arrive at the required usability and security.

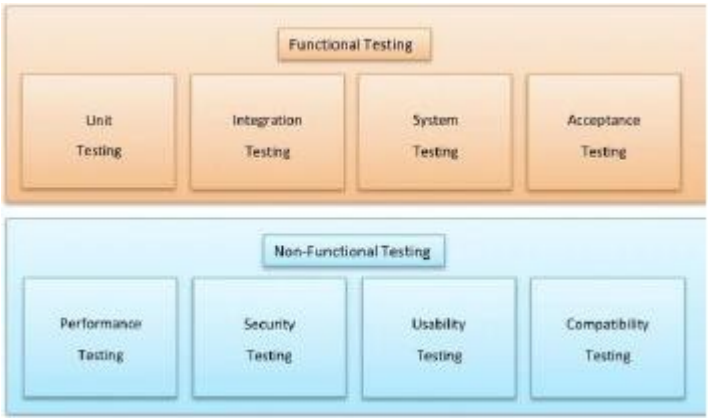

Figure 16. Function and Non-Functional Testing

Functional Testing

Usability Testing

In response to a survey about the usefulness or usability of the SBE Application, the majority of students at WCC ATC Binalonan said that the application provides a different channel of knowledge that they believe to be more interesting. The data gathered from all of the students that took part in the survey was used to obtain this information. Also, the SBE Application responses provide all of the information that is required for learning. It was seen favorably by learners because they think that this application is an effective tool for strengthening instruction and enhancing learners' capacity for information acquisition through transfer learning. Also, the respondents said that they can practice and use some basic electrical diagrams. which helps them to improve on making diagrams.

Moreover, when the learning process is designed to apply the lessons that they learned and take quizzes and make diagrams using the simulator, the control of knowledge is increased. According to the respondents, the SBE Application features an all-around innovative interface that offers the user a fulfilling and appealing user experience.

Compatibility Testing

The software undergoes different compatibility testing to know and ensure that the applications created are working in different browsers, mobile devices, gadgets, and other hard wares.

To work properly and smoothly, the application of the simulator needed a tablet or mobile phone with at least 3GB RAM and 32GB ROM but it still depends on the processor of the said device to be used. Some tablets and mobile phones experienced crashes and bugs when using the simulator, maybe the processor or other specifications needed are not that high to perform this application. Laptops and computers can also be used because the apk file or zip file can easily be shared through google drive.

Non-Functional Testing

Performance, Load, and Stress Testing

Simulator for Basic Electrical (SBE) application is created to withstand any kind of stress. It is guaranteed that the application will work if the user's personal device met the minimum hardware requirements. The researchers have conducted stress tests and found that the application will not fail or automatically close under any circumstance.

Security, and Vulnerability Testing

Simulator for Basic Electrical (SBE) is a closed application, once the application is given to the instructor it cannot be edited or added information. Only the instructors have access to the apk file of the application and they can only give it to the students who are taking the basic electrical subject. Furthermore, there will be no personal data that will be saved.

Levels of Testing

Unit Testing

Multiple testing procedures are conducted in order to make sure that the app is running completely. Before compiling the codes, the programmers conduct unit testing methodology wherein each module or subparts of the application are tested part by part before completely putting the codes into the game maker studio.

Integration Testing

The researchers issued an apk/zip file of the application to different students taking up the subject Basic electricity including their instructor. The application was then installed on different devices: android phones, tablets, and laptops. Then, the instructor proceeded to teach a lesson using the application. Right after the discussion, the students took an in-app quiz. Then, the instructor finished the discussion by teaching the students how to build a simple circuit in the in-app

simulator. Subsequently, the students were asked about their over-experience with the student using the SBE application. The results that the researchers gathered were generally positive, giving constructive comments about the user interface, and suggestions on what they would want to see in the application.

System testing

The respondents have indicated a high level of satisfaction with the modules, quizzes, and simulator provided by the SBE application. The respondents wanted to use the SBE application on their major subjects because they believe that the application would help them in answering and doing their activities in their future and present subjects.

Acceptance Testing

Simulator for Basic Electrical (SBE) is working properly and has met the researchers, users, and instructors' expectations. Some students wanted to use the application in their daily classes, specifically in laboratories. Additionally, the instructors have used the SBE application in their discussions and approved the application.

Economic Analysis

Project Cost

ECE FEE	**10,000 PHP**
IT CONSULTANT	**35,000 PHP**
TABLET	**10,000 PHP**
TOTAL:	**55,000 PHP**

Financial Analysis

The financial analysis of the SBE project reveals that bringing it to fruition will necessitate a significant investment. The total project cost is ₱55,000, which includes hardware components, software licenses, and labor. The salaries of the research team and any consultants hired for the project are included in the labor expenses.

IV. Conclusion

Summarizing the overall results of this study, the researchers achieved the goals set in this thesis project, providing basic electrical lessons to create a basic electrical module, a basic electrical quiz, and a simulator. The researchers created a simulator application called F that

contains this project aims to provide students with a learning platform in a creative, user-friendly and interactive way. The CBT application is intended for students taking electrical undergraduate courses in the Department of Avionics at WCC College of Aeronautical Technology. Evaluation and testing of the CBT application will be conducted on the campus of the WCC College of Aeronautical Technology to determine the performance of research with positive research results. The BEE-CBT application provides information on basic electrical lessons that are easy for students to use. It comes with background sounds to make it more interactive and simulators of logic gates, capacitors, resistors, LEDs and switches to give you an understanding of basic electricity. Respondents liked the application and had a lively interaction, such as trying out the simulator and taking quizzes. 2. As mentioned above, this application is Android only with the required minimum specifications and does not require an internet connection. Installing the application is very easy and can be done by students themselves. The application itself is user friendly. Respondents are interested in applications regardless of whether they can be downloaded or shared. 3. The importance of her BEE-CBT application to instructors is clearly emphasized. This means less work to deliver and prepare modules and tests. Students can also get an overview of the lessons and the Simulator Her application provides everything to learn about basic electrical topics.

This research project proved that the CBT application is an excellent educational vehicle that enables students to learn efficiently and is worth investing in. Today's generation with advanced technology. It can be said that there is more emphasis on e-learning mediums. It was a positive experience for all respondents to this research project. Its convenience and portability make it popular with students and faculty. Therefore, based on the survey results, the CBT software applications achieve excellent results in terms of functional suitability, performance efficiency, compatibility, usability, security, maintainability, and portability.

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