Exploring the Adoption of a Multifunctional Alarm System in Skills Training: An Analysis through Technology Acceptance Model

Lovenres J. Enanoria, Victor S. Rosales, Roque B. Requino, Erman S. Marajas, Antonio M. Merca

Department of Technology Teacher Education Mindanao State University-Iligan Institute of Technology, Iligan City, Philippines

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ABSTRACT

This study explores the key features, operational mechanisms, and functional advantages of a multifunctional alarm system, emphasizing its security applications and its integration into skills training for Electrical Installation and Maintenance (EIM). Grounded on the Technology Acceptance Model (TAM), the study seeks to optimize the system by integrating advanced technologies to enhance security, reliability, and user-friendliness. It further aims to evaluate the adoption level of the system by assessing user acceptance, market viability, and potential implementation challenges among teacher-trainers—graduates of Industrial Technology and allied courses—teaching TVL-E subjects in junior and senior high schools in the Division of Iligan City.

A descriptive-correlational research design utilizing mixed methods was employed. Quantitative data were collected using a validated five-point Likert scale survey and analyzed using descriptive statistics and Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate the relationships among perceived Usefulness (PU), perceived ease of use (PEU), Attitude towards use, behavioral intent to use (BIU), and actual system usage. Thirty (30) purposively selected respondents participated in the survey. Qualitative data from open-ended questions were thematically analyzed to determine patterns of opinion regarding the system's application in skills training.

The results revealed high agreement levels across all constructs: level of expertise ($M = 3.92$), perceived Usefulness ($M = 4.553$), perceived ease of use ($M = 4.040$), attitude towards use ($M = 4.392$), behavioral intent to use ($M = 4.350$), and actual system use ($M = 4.077$). All six hypothesized relationships in the structural model were statistically significant ($p < 0.05$), with the strongest path observed between behavioral intent to use and actual system usage ($\beta = 0.782$, $t = 9.811$, $p = 0.000$). Thematic analysis revealed three key themes: "Learning Experience and Development," "Seminars and Workshops," and "Simulation and Identification of Alarms," confirming the system's relevance in realistic learning environments. Validation by experts from academia, industry, and TESDA further affirmed the system's instructional applicability.

In conclusion, the study affirms the effectiveness and educational value of the multifunctional alarm system as a training device in EIM. Recommendations include the development of modular kits, integration of smart technologies, improved connectivity features, enhanced portability, and clear maintenance protocols to increase accessibility, usability, and long-term adoption.

Keywords: multifunctional alarm system, skills training, Technology Acceptance Model, technology

INTRODUCTION

With the rapid advancement in technology, the adaption and integration of innovative system skills training have become increasingly important. One such technology is the multifunctional alarm system, which combines various features such as home security, emergency alerts, and smart home automation into a single device. This system has the potential to enhance safety, efficiency, and convenience in different training environments ranging from vocational training institutes to workplace safety programs.

The Technology Acceptance Model (TAM) is a widely recognized theoretical framework for understanding and predicting the individual's acceptance and adoption of new technologies. It focuses on two key factors: perceived usefulness, which refers to individuals' perceived degree of usefulness of the technology in terms of it being effortless to use. While the adoption of multifunctional alarm systems has been extensively studied in the consumer context, their adoption and acceptance in skills training settings have received less attention. The previous training mock-up which has been used in TESDA (Technical, Educational, and Skills Development Authority) Electrical Installation and Maintenance (EIM) NC II training for Senior High School Technical and Vocational Livelihood Education (TVL) track utilizes the conventional Fire Detection and Alarm system (FDAS) of which it uses basic alarm functions such as triggering and audible siren or notifying the monitoring station in case of fire it utilizes manual call point, smoke and heat detectors, as sensors integrated in the lighting and power circuit wiring system. However, a multifunctional alarm system offers a wide range of advanced features beyond security, including home automation and integration with other devices such as smart lighting switches, smart power outlets, doors, and PIR sensors, and this can be set to arm and disarm using a keypad or by remote wireless control through the same system. This level of automation is typically not available in a conventional alarm system. Understanding the factors that influence the adoption of this system within skills training is crucial for both trainers and trainees in the senior high school students of the division of Iligan City. It can help trainers design effective training programs that incorporate functional alarm systems, and it can assist trainees in recognizing the benefits and overcoming potential barriers to using this system.

This study aims to explore the adoption of a multifunctional alarm system in skills training using the Technology Acceptance Model as a theoretical framework. By applying TAM, this research seeks to investigate the perceived usefulness and ease of use of multifunctional alarm systems among trainers in skills training contexts. It will examine other relevant factors that may influence the adoption process, such as training program characteristics, trainers' technological proficiency, and contextual factors specific to skills training environments. The findings of this study will contribute to the existing body of knowledge by shedding light on the factors influencing the adoption of multifunctional alarm systems in skills training. The insights gained from this research will inform the design and implementation of training programs that effectively integrate multifunctional alarm systems, leading to enhanced safety, efficiency, and effectiveness in a skills training environment.

The Senior High School Program is one of the conspicuous features of the Philippines' K to 12 program that was fully implemented in the school year 2016-2017. The Senior High School is a two-year specialized upper secondary education where students may choose a specialization based on aptitude, interest, and school capacity. The choice of career track will be defined by the content of the subjects a student will take in grades 11 and 12. Senior High School subjects fall under either the core curriculum or specific tracks (Official Gazette, n.d.)

The Technical Vocational and Livelihood (TVL) track is one of the tracks of Senior High School that focuses on technical vocational education and training that aims to develop the knowledge, skills, and Attitudes of the students. Electrical Installation and Maintenance National Certificate 2 (EIM NC 2) is one of the specializations in the Industrial Arts Strand of the TVL Track. This specialization is commonly offered in most public senior high schools in the country. This specialization will enable the students to be certified skilled electricians if they pass the National Assessment of TESDA. This, in turn, will make the students employable since most of the industries, locally and globally, require at least a National Certificate Level II.

According to SEAMEO INNOTECH (2014), one of the innovative outputs in Senior High School modeling is encouraging SHS teachers to conduct action research and develop their instructional materials to help enrich existing instructional materials. This innovative output will help the teachers to enhance their knowledge, skills, Attitude, and technology for them to have an output. The effectiveness of the teachers in imparting the knowledge, skills, and the transfer of technology is also done through the Teachers' innovative skills.

According to a study on the Acceptability of a developed fire detection and alarm system (FDAS) Trainer by Cayaco (2019). The research involves seven senior high school faculty members from the northeastern part of Leyte Province. This sample size is limited in numbers, and it is geographically restricted in terms of scope, which limits the generalizability of the findings. Having a larger and more diverse sample from various schools in a district or even in a division would enhance the study's validity and provide a more comprehensive understanding of the acceptability of the training device. Secondly, the study lacks a comparison with the existing training methods; although it evaluates their acceptability, it does not compare their effectiveness or efficiency with the existing methods. Comparing the device outcomes, such as knowledge acquisition, skills development, and Attitude improvement, with traditional or alternative training approaches would provide insights into the device's added value and potential areas of improvement. Thirdly, the paper has limited evaluation criteria. The study assesses the acceptability of the training device based on three criteria, namely design, performance, and safety. While these aspects are essential, there might be other factors that impact the device's effectiveness, such as usability, interactivity, engagement, and adaptability to the different student's learning styles and methods. Expanding the evaluation criteria to encompass a broader range of factors would provide a more comprehensive understanding of the device's overall effectiveness. Fourth is the need for the study to have a longer analysis because it focuses on evaluating the training device's acceptability based on a single assessment. However, incorporating longitudinal analysis to measure the retention of knowledge, skills, and Attitudes over time would provide insights into the long-term impact of the training device on learner's competency development. While the study evaluates the acceptability of the training device, it does not explore validity, practical implementation challenges, and potential barriers to its adoption in training programs. Examining factors such as cost-effectiveness, availability, scalability, and integration with the existing curricula would provide insights into the device's feasibility and potential for widespread implementation.

Addressing these research gaps would strengthen the study's findings and contribute to the development and improvement of the training device for FDAS installation and troubleshooting, ensuring the effective transfer of knowledge skills and Attitude to learners in the field of electrical installation and related programs.

Statement of the problem

The purpose of this study is to investigate the adoption of a multifunctional alarm system in skills training using the framework of the technology acceptance model (TAM). With the advancement in technology, the integration of multifunctional alarm systems has become a potential solution for enhancing safety and efficiency in various training environments. However, the acceptance and utilization of such a system in skills training settings are still relatively unexplored. This research aims to fill this gap by examining the factors influencing the adoption of a multifunctional alarm system in skills training, primarily focusing on the variable proposed by (TAM). By understanding the perception and attitudes of trainers and trainees towards this system, as well as their perceived usefulness and ease of use, this study seeks to provide valuable insights into the successful implementation and utilization of multifunctional alarm systems in the skills training context.

Objectives of the Study

This study aims to describe the key features of the device's operational mechanism and the functional advantages of the multifunctional alarm system and its various security applications. To optimize the multifunctional alarm system by integrating advanced technologies to enhance security, reliability, and user-friendliness and to evaluate the adoption level of the system by assessing user acceptance, market viability, and potential implementation challenges of a multifunctional alarm system in skills training of the teacher trainers who are graduates of DTTE prominent in Industrial technology and other allied equivalent courses related to electrical and electronic technology handling TVLE subjects in junior and senior high school. Its perceived usefulness, ease of use, and the behavioral intent to use this device as a trainer for Electrical Installation and Maintenance are aimed in this study. The output of the research is the respondents' acceptability of this trainer module. More specifically, this study seeks to achieve the following:

1. To determine the level of expertise of Teachers-Trainers in using multifunctional alarm systems in skills training
2. To examine the teacher/trainer's perception of key features, security, and alert mechanism of the multifunctional alarm system in terms of:
    a. Perceived Usefulness
    b. Perceived ease of use
    c. Behavioral intent to use.
3. To determine the design parameters needed for an efficient multifunctional alarm system that could

influence users:

a. Perceived Usefulness
b. Perceived ease of use
c. Behavioral intent to use.

By addressing these objectives, this study aims to contribute to the development of a more effective and user-friendly alarm system that can enhance the safety and security of individuals and communities.

Hypotheses of the study

The study is guided by the following hypotheses based on the Technology Acceptance Model (TAM)

H1: Perceived Usefulness significantly influences the Attitude Toward the Use of the multifunctional alarm system.

H2: Perceived Ease of Use significantly influences the Attitude Toward Use of the system.

H3: Perceived Ease of Use significantly influences the Perceived Usefulness of the system.

H4: Attitude Toward Use significantly influences the Behavioral Intention to Use the system.

H5: Perceived Usefulness significantly influences the Behavioral Intention to Use the system.

H6: Behavioral Intention to Use significantly influences the Actual System Use of the multifunctional alarm system.

Theoretical Framework

The Technology acceptance model (TAM) by Davis (1989) has been widely used in studies exploring the acceptability of various technological solutions. Within the context of multifunctional alarm security systems, there are several factors influencing consumer's willingness to adopt a particular product, such as perceived usefulness, ease of use, and social influence. In this study, we aim to evaluate the acceptability of a multifunctional alarm system using the TAM model. This research investigates how the TAM constructs of perceived usefulness, perceived ease of use, and subjective norm impact consumers' attitudes towards adopting a system that combines both wired and wireless Technologies. The researcher believes that this study will offer valuable insights to security system manufacturers and consumers looking to make informed decisions regarding home technology.

One study conducted and utilizes the technology acceptance model (TAM) as the theoretical framework to assess the adoption of an alarm system product is "User acceptance of smart home technology and its impact on the environment: A case study of COZIE smart alarm system "(Babatunde et al., 2021). The study was conducted using a survey of 250 homeowners in the UK, and structural equation modeling was used to analyze the data collected. The findings showed that perceived usefulness, ease of use, and compatibility were significant predictors of user intention to adopt the COZIE alarm system. The study also found that the perceived environmental benefits of using the product positively influenced user adoption intention. Overall, the study demonstrated the Usefulness of the TAM in assessing user acceptance of smart home technology and its impact on environmental sustainability.

Furthermore, this theoretical framework can help the researcher understand why people may or may not accept a multifunctional alarm system and how it can be designed to improve its acceptability.

Conceptual framework of the study

Figure 1.1 shows the conceptual framework of this study. The methodology of this study uses the Technology Acceptance Model by Davis (1989). There are independent variables and dependent variables that determine the

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acceptability of the Multifunctional alarm system.

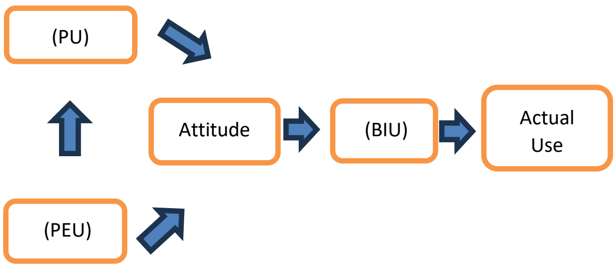

Figure 1.1 shows the relationship between the variables

The Independent variables were the product's perceived usefulness and perceived ease of use and the behavioral intention to use that leads to the Trainer's willingness to accept and use the technology in skills training.

The study also considers the factors that affect acceptance of the alarm system, such as its functionality, reliability cost, and comparability with other technologies.

METHODOLOGY

Research Design

This study employed a descriptive-correlational quantitative method combined with Qualitative Thematic Analysis. The quantitative aspect determines the relationship among constructs of the Technology Acceptance Model (TAM), such as Perceived Usefulness, Perceived Ease of Use, Attitude towards Use, Behavioral Intent to Use, and Actual Use of the System. The qualitative component explored participants' insights and suggestions.

The quantitative research data uses a structural equation model to analyze both direct and indirect relationships among multiple variables. At the same time, it examines how factors like perceived usefulness and ease of use influence behavioral intention, and actual system use (PLS-SEM) can also effectively model this as latent variables, thereby reducing measurement errors. It also incorporates Confirmatory Factor Analysis Integration, which helps validate whether the survey items truly measured the intended TAM constructs, ensuring construct validity along with prototype testing would provide valuable insights into the acceptability of the multifunctional alarm system prototype and guide its further development.

Research Setting

This research was carried out at the Division of Iligan City, Department of Education. Most of the target respondents of this study were under the Department of Education in the division of Iligan City. They were Junior High and Senior High School Teachers within the Division. Some of them are working as Trainers of TESDA Technology Institutions (TTI), a public training center or schools operated and managed by TESDA or Accredited schools (Technical-Vocational Institutions) that offer Electrical Installation and Maintenance Courses

The division of Iligan City has diligently expanded to its current structure, comprising thirty-one public secondary schools, including annexes and integrated schools and seven TESDA-accredited Technical-Vocational Institutions (TVIs).

Research Subjects

The respondents of the study were 30 Teacher-trainers of the whole district of the division of Iligan City, Lanao del Norte, the Philippines, who are directly and indirectly aware of their multifunctional alarm system. The approach uses survey questionnaires to gather data. In addition, the researcher used purposive sampling in choosing the respondents. The respondents are male or female, with an age range of 24 - 65 years old. The respondents could be TVLE teachers who are ITE majors or any allied equivalent courses who are handling

TVLE subjects of their respective schools in districts of the Iligan City division, married, widows, or separated. The respondents will participate according to their availability.

Research Instruments Used

In gathering the data, the instruments used in this study were modified TAM survey questionnaires that address analysis and evaluation by which the respondents rated them accordingly. The prototype of this study also, at the same time, underwent an evaluation by a group of experts from the industry sector, from the academe, and the Technical Skills Development Authority (TESDA) Trainor and assessors. Their role was to conduct group discussion and phase evaluation of the system in terms of functionality of its key features, such as how this device operates, its Usability, and safety aspects. To ensure sufficient usability of products and technical systems, usability evaluation methods. Recent studies emphasize the crucial role of usability evaluation in the successful adoption of technical systems (Adams et al., 2023; Darejeh et al., 2024). In particular, cognitive overload and interface complexity have been shown to impact user engagement and perceived usefulness negatively (Maqbool & Herold, 2024). These findings align with the Technology Acceptance Model (TAM), which underpins this study on the adoption of a multi-functional alarm system in skills training. In addition, demographic data on the respondents in this study were collected, including their age, sex, civil status, Program graduated and major, school location, employment position, teaching grade level, and years of service. The quantitative data were gathered using a structured questionnaire adapted from validated TAM-based instruments (Venkatesh & Davis, 2000). It was modified to fit the context of the multifunctional alarm system. The questionnaire consisted of items rated on a 5-point Likert scale, ranging from "Strongly Disagree" (1) to "Strongly Agree" (5), assessing the following constructs:

1. Expertise
2. Perceived Usefulness
3. Perceived Ease of Use
4. Attitude Toward Use
5. Behavioral Intention to Use
6. Actual Use

To gather qualitative data, the survey also included two open-ended questions that elicited user experiences and suggestions for system improvement.

The instrument was validated by experts in the academe, industry, and technical training institutions, ensuring content and construct.

Data Gathering Procedure

First, the researcher writes a letter of permission to conduct a study. Second, the researcher asked for the approval of each respondent through written informed consent. Third, the researcher guarantees the respondents' anonymity and complete confidentiality based on their responses. Fourth, the study's respondents will be gathered through simple purposive sampling. Finally, the Language of the instrument will be in English Language.

Lastly, the researcher distributed the questionnaires personally or online. The respondents will help guide the data-gathering process. The respondents were given sufficient time to answer the questions in exploring the adoption of a multifunctional alarm system in skills training: An analysis through technology acceptance model test and the questionnaires. The researcher will provide the availability and time of the respondents' consideration.

Data Analysis Technique

Quantitative data were analyzed using descriptive and inferential statistical techniques. Descriptive statistics, including frequencies, percentages, means, and standard deviations, summarized the responses to the Likert scale items and provided a clear picture of the respondents' perceptions of the multifunctional alarm system.

Partial Least Squares Structural Equation Modeling (PLS-SEM) was utilized for inferential analysis due to its effectiveness in handling complex, multi-variable models and smaller sample sizes. PLS-SEM helped examine the strength and significance of relationships among the Technology Acceptance Model (TAM) constructs: Perceived Usefulness (PU), Perceived Ease of Use (PEU), Attitude towards Use, Behavioral Intention to Use, and Actual Use of the system. Model validity and reliability were assessed through indicators such as Cronbach's alpha, composite reliability (CR), Average Variance Extracted (AVE), and discriminant validity.

Qualitative data were analyzed through thematic analysis, following a systematic process of data familiarization, generating initial codes, searching for themes, reviewing and refining themes, defining and naming themes, and producing a report. This approach allowed for capturing detailed insights into user experiences, highlighting areas for improvement, and identifying specific recommendations.

Triangulation was applied by integrating qualitative and quantitative findings to enhance the credibility and validity of the research outcomes, providing a comprehensive understanding of the adoption of the multifunctional alarm system.

RESULTS AND DISCUSSIONS

Teacher-trainers' level of expertise in using multifunctional alarm systems in skills training.

Expertise is the result of deliberate practice; it requires individuals to engage in specific activities designed to improve performance over a long time (Ericsson, 2006)

Table 1 Level of Expertise in the Adoption of a Multifunctional Alarm System

Indicator	Mean	SD	Interpretation
A. Expertise			
1. I have sufficient expertise to use this multifunctional alarm system in skills training effectively.	3.967	0.964	Agree
2. I feel confident in my ability to use the multifunctional alarm system in skills training.	3.967	0.928	Agree
3. I have prior experience with multifunctional alarm systems.	3.833	0.913	Agree
Over-all Mean	**3.922**	**0.935**	**Agree**

The table titled "Level of Expertise in the Adoption of a Multifunctional Alarm System" presents statistical data evaluating users' expertise in using a multifunctional alarm system for skills training.

The first indicator assesses whether users believe they have sufficient expertise to use the system effectively, with a mean score of 3.967 and an SD of 0.964, interpreted as "Agree." Similarly, the second indicator measures users' confidence in using the system, showing the same mean score (3.967) but a slightly lower SD (0.928), also interpreted as "Agree." The third indicator focuses on prior experience with the system, which has a slightly lower mean score of 3.833 and an SD of 0.913 yet is still interpreted as "Agree." The overall mean score across all indicators is 3.922, with an SD of 0.935, indicating that users generally agree that they possess the necessary expertise to use the multifunctional alarm system. Measuring the level of expertise in operating multifunctional alarm systems involves assessing both the technical knowledge and practical skills of individuals. Literature on this topic often focuses on training methods, system design, and evaluation frameworks that enhance user expertise.

Studies emphasize the importance of experiential learning in developing expertise. For instance, the development of an addressable fire alarm system trainer aimed to enhance emergency responders' skills through hands-on activities. This approach allows learners to manipulate system components and understand their functions better. Simulation environments can mimic real-world scenarios, providing a safe space for users to practice and refine their skills without risking actual system malfunctions. Systems designed with user needs in mind can facilitate more straightforward operations and reduce errors. The FURPS model, which assesses functionality, usability, reliability, performance, and supportability, is used in evaluating alarm systems. This framework ensures that systems are intuitive and accessible to users with varying levels of expertise. Clear visual and auditory cues help users understand system states and respond appropriately, enhancing their expertise over time.

The relatively high mean scores suggest that users feel confident and capable of utilizing the system. The standard deviations indicate a moderate spread in responses, meaning that while most users agree on their expertise, there is some variation in individual responses. This data implies that users have a strong foundational understanding of the system, though there may be room for additional training or experience to enhance overall proficiency.

Teacher-Trainers perception of key features, security, and alert mechanism of the multifunctional alarm system in terms of Perceived Usefulness (PU)

Table 2 Level of Perceived Usefulness in the Adoption of a Multifunctional Alarm System

Perceived Usefulness (PU)	**Mean**	**SD**	**Interpretation**
1. Using this multifunctional alarm system in skills training would enhance my work or task.	4.500	0.572	Strongly Agree
2. Using this multifunctional alarm system in skills training will improve my performance.	4.600	0.563	Strongly Agree
3. I believe that a multifunctional alarm system will improve my Productivity.	4.600	0.563	Strongly Agree
4. I find the multi-alarm system beneficial in my work.	4.567	0.626	Strongly Agree
5. The multi-alarm system is valuable in achieving my goal.	4.500	0.630	Strongly Agree
Over-all Mean	**4.553**	**0.590**	**Strongly Agree**

The table titled "Level of Perceived Usefulness in the Adoption of a Multifunctional Alarm System" presents statistical data on how users perceive the benefits of using the multifunctional alarm system in skills training.

The first indicator evaluates whether using the system enhances work or tasks, showing a mean score of 4.500 and an SD of 0.572, interpreted as "Strongly Agree." The second and third indicators assess whether the system improves performance and productivity, both having a mean score of 4.600 and an SD of 0.563, which also fall under "Strongly Agree." The fourth indicator measures the perceived benefit of the system in work, yielding a mean score of 4.567 and an SD of 0.626, while the fifth indicator focuses on the system's value in achieving goals, showing a mean score of 4.500 and an SD of 0.630. Both of these indicators are similarly interpreted as "Strongly Agree." The overall mean score for all indicators is 4.553, with an SD of 0.590, reinforcing the overall perception that users strongly agree with the usefulness of the system.

The high mean scores across all indicators suggest that users perceive the multifunctional alarm system as highly beneficial for improving work performance, productivity, and goal achievement. The relatively low standard deviations indicate consistency in responses, implying a strong agreement among users. This data highlights the effectiveness of the system in enhancing efficiency and productivity, making it a valuable tool for skills training.

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The concept of perceived usefulness plays a critical role in the adoption of technological systems, including multifunctional alarm systems.

The Perceived Usefulness of alarm systems is often linked to their ability to enhance safety, reduce workload, and improve user experience, according to Al Haddad et al. (2022). For instance, the i-DREAMS system, a multi-modal warning-monitoring system, demonstrated that users found it beneficial for maintaining safe behavior, improving performance, and increasing situational awareness. Factors such as clarity of visuals and ease of understanding were also identified as contributing to perceived usefulness.

Design parameters are needed for an efficient multifunctional alarm system that could influence users' Perceived Ease of use.

Table 3 Level of Perceived Ease of Use in the Adoption of a Multifunctional Alarm System

Perceived Ease of Use (PEU)	**Mean**	**SD**	**Interpretation**
1. I am confident that I can learn to use the multifunctional alarm system in skills training easily.	4.400	0.498	Agree
2. I am not intimidated by the multifunctional alarm system.	3.900	0.960	Agree
3. It is easy for me to find the information I need when using the multifunctional alarm system.	4.133	0.681	Agree
4. The multifunctional alarm system is easy to use.	4.067	0.785	Agree
5. The multifunctional alarm system is well-organized and easy to navigate.	4.000	0.788	Agree
6. I am confident that I can overcome any problems I have in using the multifunctional alarm system.	4.100	0.662	Agree
Over-all Mean	**4.040**	**0.729**	**Agree**

The table titled "Level of Perceived Ease of Use in the Adoption of a Multifunctional Alarm System" presents statistical data on users' perceptions regarding how easy it is to learn, navigate, and use the multifunctional alarm system.

The first indicator evaluates confidence in learning to use the system easily, with a mean score of 4.400 and an SD of 0.498, interpreted as "Agree." The second indicator assesses whether users feel intimidated by the system, showing a slightly lower mean score of 3.900 and a higher SD of 0.960, suggesting some variation in user confidence. The third indicator measures the ease of finding information within the system, with a mean score of 4.133 and an SD of 0.681, also interpreted as "Agree."

The fourth and fifth indicators focus on the system's overall ease of use and organization. The ease-of-use indicator has a mean score of 4.067 and an SD of 0.785, while the organization and navigation aspect has a mean of 4.000 with an SD of 0.788. The final indicator evaluates users' confidence in overcoming problems when using the system, showing a mean of 4.100 and an SD of 0.662. All indicators are interpreted as "Agree," indicating a consensus that the system is user-friendly.

The overall mean score is 4.040, with an SD of 0.729, reinforcing that users generally agree on the system's ease of use. However, the higher standard deviation in some indicators, particularly the second one, suggests that

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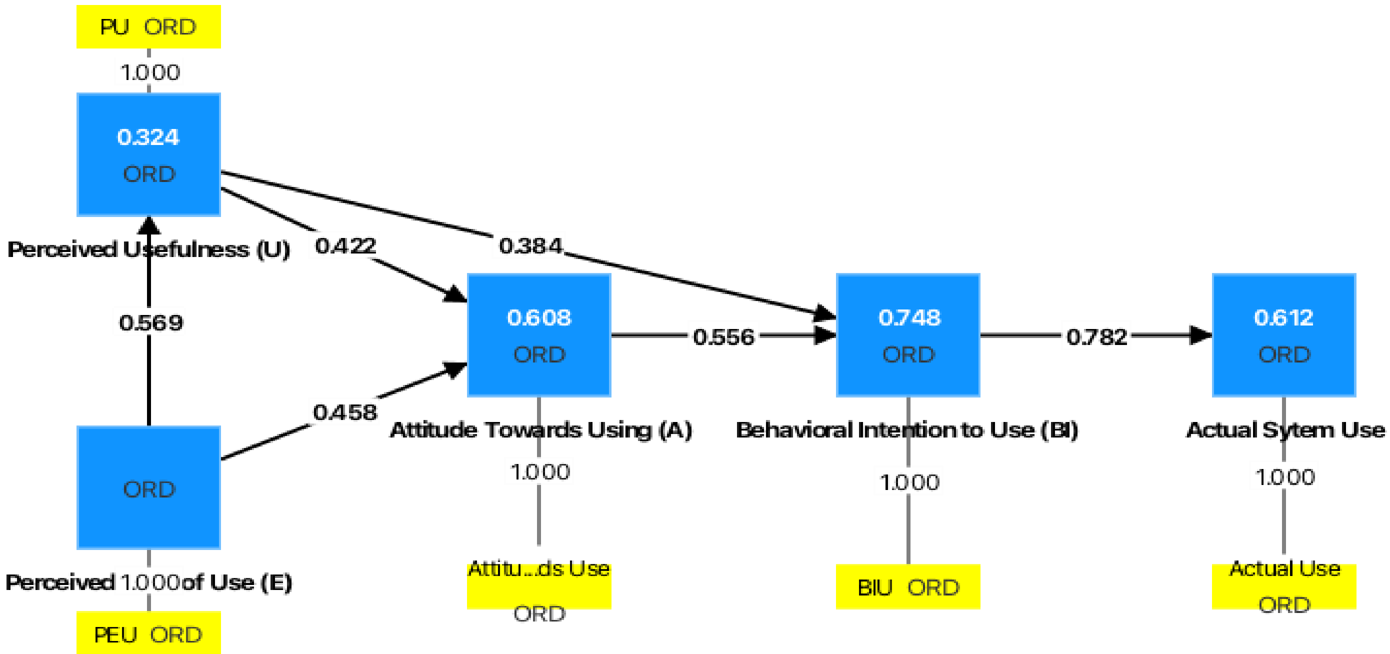
while most users find the system easy to use, a few may experience difficulties or require additional support. Overall, the data suggests that the multifunctional alarm system is perceived as well-structured and user-friendly, though some minor usability improvements could enhance the experience further.

The perceived ease of use (PEOU) is a critical determinant in the adoption of technological systems, including multifunctional alarm systems. The Technology Acceptance Model (TAM) posits that perceived ease of use significantly influences users' intention to adopt technology. It is defined as the degree to which an individual believes that using a system will be free from effort. In the context of e-filing systems,Tahar et al. (2020) found that perceived ease of use and security significantly influenced the adoption of e-filing systems, whereas perceived usefulness had no significant effect. This insight is particularly relevant to the present study, as it suggests that for the multi-functional alarm system to be adopted in skills training, it must not only serve its intended function but also offer a user-friendly experience. Thus, ease of use may act as a more critical factor than usefulness alone, particularly among TVL-E teachers who operate in the practical, time-constrained learning environment

Table 4 Table shows the hypothesized results using PLS-SEM analysis

Summary of the table "Structural Equation Model Analysis"

Hypothesis	Measurement Model (Path)	Est.	t	p	Interpretation
H1	PEU → Usefulness	0.569	4.995	0.000	**Significant**
H2	PEU → Attitude	0.458	3.652	0.000	**Significant**
H3	PU → Attitude	0.422	3.135	0.002	**Significant**
H4	PU → Intention	0.384	2.684	0.007	**Significant**
H5	Attitude → Intention	0.556	4.091	0.000	**Significant**
H6	Intention → Actual Use	0.782	9.811	0.000	**Significant**



The Structural Equation Model (SEM) analysis results presented in Table 4.7 highlight the relationships between key constructs in the study, specifically focusing on Perceived Ease of Use (PEU), Perceived Usefulness (PU), Attitude, Intention, and Actual Use. The results show the estimated path coefficients, t-values, and p-values, with all paths found to be statistically significant.

The path coefficient (0.569) is relatively high, indicating that Perceived Ease of Use has a strong positive impact on Perceived Usefulness. The t-value (4.995) and p-value (0.000) confirm that this effect is statistically significant. Perceived Ease of Use also positively influences Attitude (0.458), showing that ease of use contributes to a more favorable attitude toward the system. The relationship is significant, with a t-value of 3.652 and a p-value of 0.000. Perceived usefulness has a significant positive impact on Attitude (0.422), meaning that users who find a helpful system also develop a more favorable attitude toward it. The significance level (p = 0.002) supports this relationship. Perceived usefulness directly affects behavioral intention (0.384), suggesting that perceived usefulness drives users' intention to adopt the system. The relationship is statistically significant (p = 0.007).

Attitude strongly influences intention (0.556), reinforcing the idea that a positive attitude increases the likelihood of system adoption. The effect is significant (p = 0.000).

The strongest relationship in the model is between Intention and Actual Use (0.782), meaning that users who intend to use the system are highly likely to do so. The p-value (0.000) and t-value (9.811) confirm the robustness of this relationship.

The results align with the Technology Acceptance Model (TAM), confirming that both Perceived Ease of Use (PEU) and Perceived Usefulness (PU) are critical factors influencing user Attitude, which in turn drives Intention and, ultimately, Actual Use. The strongest predictor of Actual Use is Intention (0.782), indicating that interventions aimed at increasing user intention will likely lead to greater adoption. Additionally, Perceived Usefulness significantly impacts both Attitude and Intention, reinforcing its crucial role in system acceptance. Meanwhile, Perceived Ease of Use primarily influences Usefulness and Attitude, suggesting that enhancing ease of use can indirectly improve adoption by increasing the system's perceived benefits.

Table 5 Themes for multifunctional alarm systems

Themes "multifunctional"	**Sub-themes**
1. Learning experience and development	• Gain learner's interest • In addition to the teaching style
2. Seminars and workshops	• Demonstrating functions • Subject integration
3. Simulate and identify different types of alarms	• Life-saving alarms (such as fire) • Security for properties

Learning experience and development.

"It suits the needs of skills training and development." 7

"This multifunctional alarm system offers a new type of learning experience to the students. Students will be more interested in this new Trainer's module because it is relevant to their lives." 11

"Multifunctional alarm system integrated with a skills training environment can be highly beneficial as it enhances safety, efficiency, and the overall learning experiences." 14

"The multifunctional alarm system can be helpful in my teaching, especially in ICT." 15

"It is useful to serve as a trainer using a multifunctional alarm system. It helps hone the knowledge of our students." 19

Seminars and workshops

"It is observable mostly in schools concerning the school and community DRRM integrated in some subjects offered." 2

"The multifunctional alarm system is useful when demonstrating the function of the system to the learners. For example, when you are going to activate the system." 3

"Through a series of seminars and workshops." 6

"It can be used in workshops laboratory for my students to enhance their ability in installation and troubleshooting like giving them scenarios/problems to perform using the multifunctional alarm system, for example, identifying whether it is a true or false alarm, fault and the locating the exact place of the alarm source." 18

"If the fire alarm system is not yet wired, by the instructor, it would be challenging for me to put necessary accessories like resistors." 26

"It may integrate into other subjects, especially in terms of skills." 27

"Multifunctional alarm system can be integrated into skills training environment by simply offering more specific and helpful instructions into its desired application." 30

Simulate and identify different types of alarms (e.g., safety alarms, smoke alarms, heat sensors)

"For emergency purposes." 1

"Although integrating a multifunctional alarm system into a skills training setting can be quite successful, its effectiveness frequently hinges on how well it fits the demands and objectives of the particular setting. Like for example, In a fire safety training session, the alarm system can simulate different types of fire alarms (e.g., smoke alarms, heat sensors) to create realistic scenarios. Trainees learn to identify the alarm types and practice evacuation procedures under time pressure." 5

"With the aid of a multifunctional system, safety, efficiency, and timeliness will be assured." 9

"It is helpful to build construction since the fire alarm system is part of a building." 14

"It is good to integrate the multifunctional alarm system with a skills training environment to ensure safety on properties and well-being." 16

"It should be used to integrate to protect the system of building and its property and life. And to expose trainees to upgraded alarm systems." 17

"The multifunctional alarm system integrates well with the skills training environment by providing real-time alerts during fault simulations, enhancing hands-on learning, though it can be challenging for beginners to interpret complex signals effectively." 20

"Use for efficient service in detecting fire incidents." 23

"In Safety Alerts." 24

"In my opinion, a multifunctional alarm system enhances the skills training environment by providing real-time

alerts that help learners stay focused and respond quickly to critical scenarios, such as emergency simulations. However, it can be challenging to integrate effectively in highly dynamic training sessions where alarms may distract from complex tasks or confuse participants if not calibrated properly." 26

"Use for life-saving devices as an alarm for fire." 28

What improvements or additional features would you suggest to enhance the usability and effectiveness of the multifunctional alarm system in skills training?

Table 6 Themes for multifunctional alarm system

Themes "Usability and Effectiveness"	Sub-themes
1. Modular model	• Usable for educators and learners • Knowledgeable Trainer • Trials and practices • Training modules
2. Accessibility and identification	• Internet-connected • Phone networks • Terminal log • Connectivity to external platforms (Arduino) • Identification of specific alarms
3. Advanced technology	• Using AI for Real-Time Feedback Integration • Using AI for Smart-scheduling • Using AI for Smart sensors • Using Visual and Haptic Feedback
4. Portability	• Cheaper and smaller
5. Maintenance	• Regular maintenance • Troubleshooting
6. Customizable	• User-dependent

Modular model

Modular model and internet-connected." 2

"It is good, and the developer can improve it more by making it usable for the educators and students." 15

"For the improvement of the said training, it is important that the trainer has full knowledge in terms of the electrical side." 17

"More trials, tests, practices, and problem solving to generate and come up with another new idea that could improve the present multifunctional alarm system." 18

"Make it a trainer so that the students can simulate different activities. Use banana jack and sockets for easy

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simulation activities." 19

"To enhance usability, I would suggest incorporating customizable alert patterns and adaptive feedback that align with specific training modules, allowing for a more tailored and context-sensitive experience." 25

"Let the learners explore the usefulness of multifunctional alarm system and encourage them to perform." 27

"A very detailed procedures and diagram should be provided so that it would be easier to use." 30

Accessibility

"Additional features that can be accessed immediately." 3

"More specific and precise alarm system." 6

"Add more features that can be remotely controlled using wifi to make it more adaptable to smart home." 11

"Can the fire alarm system inte "Multifunctional alarm system is good enough, if internet connection is needed it will require a stable connection." 16

"Stablish terminal log in its connection." 23

"Actual installation in building." 24

"Needs to ensure to integrate in technology, especially in computer or phone networks." 28

grate with the Arduino." 12

"Multifunctional alarm system is good enough, if internet connection is needed it will require a stable connection." 16

"Stablish terminal log in its connection." 23

"Actual installation in building." 24

"Needs to ensure to integrate in technology, especially in computer or phone networks." 28

Advanced technology

"I think these are some of the additional features to add:

-Real-Time Feedback Integration

-Smart Scheduling

Use AI to analyze schedules and suggest optimal times for alarms based on past activity and focus levels.

-Visual and Haptic Feedback

Add flashing lights or color-coded displays to supplement sound for environments where audio alarms may not be suitable." 5

"Digitalization." 8

"Incorporate AI to adjust alarms based on the user's performance or skill acquisition progress." 13

"Maybe integration of smart sensors that trigger alarms." 14

Portability

"The current prototype is good, and if needs improvement, I suggest making it cheaper and smaller to minimize space." 7

Maintenance

"To be assured of a satisfactory functionality of the multifunctional alarm system, regular maintenance must be done." 9

"Proper troubleshooting of fire alarm." 26

Customizable

"Depends on the user." 20

"Self-application in a constant manner." 22

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary of Findings

This study aimed to assess the integration and effectiveness of a multifunctional alarm system in a skills training environment, using both quantitative and qualitative methods. The quantitative analysis was conducted through Structural Equation Modeling (SEM), while qualitative insights were gathered through open-ended responses from educators and trainees.

Quantitative Findings

The SEM analysis revealed significant relationships among key constructs of the Technology Acceptance Model (TAM), highlighting the following results:

1. **Perceived Ease of Use (PEU) → Perceived Usefulness (PU)** ($\beta = 0.569$, $p = 0.000$): A strong positive relationship, indicating that ease of use significantly influences how useful the system is perceived to be.
2. **Perceived Ease of Use (PEU) → Attitude** ($\beta = 0.458$, $p = 0.000$): Ease of use also significantly contributes to a favorable user attitude.
3. **Perceived Usefulness (PU) → Attitude** ($\beta = 0.422$, $p = 0.002$): The system's usefulness shapes user attitudes toward it.
4. **Perceived Usefulness (PU) → Intention to Use** ($\beta = 0.384$, $p = 0.007$): Users' behavioral Intention to adopt the system is influenced by its perceived usefulness.
5. **Attitude → Intention to Use** ($\beta = 0.556$, $p = 0.000$): A positive attitude significantly drives intention.
6. **Intention to Use → Actual Use** ($\beta = 0.782$, $p = 0.000$): The strongest relationship, showing that intention strongly predicts actual system use.

These results confirm that PEU and PU are vital factors influencing Attitude, Intention, and actual use of the multifunctional alarm system. The most critical predictor of actual use was user intention. However, the researcher acknowledges potential limitations on the validity of the results, considering the number of respondents in the study is 30. Because the minimum standard sample size required for the study on the adoption of a multifunctional alarm system in skills training using the technology acceptance model (TAM) depends on several factors, namely statistical power and effect size, a standard guideline is used by Cohen's (1988) rule which suggest a medium effect size of (0.3) and a power level of (0.80) second is using the previous (TAM) studies as reference and many (TAM) based studies use **Structural Equation Modeling (SEM)** which typically requires a minimum sample size of 150-200 respondents to ensure model validity (Hair et al.,2010). The original (TAM) study used 107 respondents in initial validation. Davis (1989) and Amin et al. (2014) (TAM-based study on e-learning adoption) used 200 respondents. The effect size measures the strength of relationships between variables of the study. A larger effect size means a stronger relationship, allowing for a smaller sample size, while a smaller effect size requires more data to detect the relationship.

The participants were selected from different high school teachers and trainers handling (TLE) electrical installation and maintenance subjects in junior and senior high schools, both public and private schools within the division of Iligan city; hence, there were little issues with sampling biases of the data gathered on the Other hand the generalizability of the results can be seen on the results on the data shown above.

Qualitative Findings

The qualitative analysis revealed three key themes regarding the system's integration into the skills training environment:

1. **Learning Experience and Development**: The system generated learner interest, enhanced teaching styles, and provided a new educational experience by simulating real-life scenarios.
2. **Seminars and Workshops**: The system was valuable for demonstrations, hands-on training, and integration into workshops, allowing learners to practice installation, troubleshooting, and alarm identification.
3. **Simulation and Identification of Different Alarms**: The system was recognized for its capability to simulate life-saving alarms (fire, smoke, and heat sensors), supporting safety drills, and building construction-related training.

Suggestions for improvement emerged across six categories:

1. **Modular Design**: Requests for training modules, detailed diagrams, and simulation-friendly components.
2. **Accessibility**: Proposals for internet and phone network connectivity, terminal logs, and Arduino integration.
3. **Advanced Technology**: Recommendations to incorporate AI-based real-time feedback, smart scheduling, and smart sensors.
4. **Portability**: Suggestions for a smaller, cost-effective version.
5. **Maintenance**: Emphasis on regular system maintenance and troubleshooting.
6. **Customizability**: Demand for user-dependent adjustments and tailored features.

CONCLUSION

The integration of both quantitative and qualitative findings underscores the effectiveness of the multifunctional alarm system in enhancing learning and training outcomes. The quantitative data confirmed that perceived ease of use and usefulness significantly influence attitudes and intentions, ultimately leading to actual system usage. The qualitative feedback reinforced this, showing that the system is valued for providing realistic learning simulations, enhancing safety training, and offering versatility across different educational contexts.

However, both sets of findings reveal opportunities for improvement. Users desire a more modular, accessible, and customizable system integrated with modern technologies and supported by thorough maintenance protocols. Overall, the study affirms that the multifunctional alarm system is a powerful tool for education and skills development when designed with user-friendliness, advanced technology, and adaptability in mind.

RECOMMENDATIONS

Based on the study's integrated findings, the following recommendations are made:

1. Develop Modular Training Kits: Include comprehensive, easy-to-understand manuals, detailed diagrams, and modular components to facilitate ease of use for both educators and students.

2. Enhance Connectivity Features: Integrate internet, phone networks, and compatibility with platforms like Arduino to promote advanced simulations and remote monitoring.

3. Incorporate Advanced Technology: Embed AI-powered smart sensors, real-time feedback systems, and smart scheduling features. Include visual and haptic alerts to accommodate diverse learning environments.

4. Improve Portability and Affordability: Redesign the system to be compact and budget-friendly, enabling broader access and integration into various training environments.

5. Establish Regular Maintenance Protocols: Provide clear maintenance guidelines and troubleshooting procedures to ensure the reliability and longevity of the system.

6. Offer Customizable Features: Allow for user-defined settings, enabling adaptability to different educational modules, skill levels, and institutional needs.

7. Strengthen Training for Educators: Conduct regular seminars and workshops to ensure educators are well-equipped to integrate and maximize the use of the system in their instructional strategies.

8. Pilot Testing and Feedback Loops: Implement regular pilot tests and gather continuous feedback from users to refine the system and address emerging needs.

9. By adopting these recommendations, educational institutions and training centers can further enhance the effectiveness and sustainability of the multifunctional alarm system as a teaching and learning tool.

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