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# DEVELOPMENT AND EVALUATION OF A TRAINER FOR SENSOR TECHNOLOGY

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## ABSTRACT

This study focused on evaluating user perceptions regarding the effectiveness of a developed sensor technology trainer for ELX 213- Sensor Technology. Using the Department of Science and Technology (DOST) Technology Assessment Protocol, the trainer was assessed in terms of technical feasibility, economic and financial viability, environmental soundness, political acceptability, and social acceptability. A total of 40 respondents, composed of students and faculty members, participated in the evaluation using a standardized Likert-scale questionnaire. Descriptive statistical analysis revealed high acceptability across all domains. The results confirm the trainer's potential for institutional integration, alignment with national educational standards, and relevance to localized technical education needs.

**KEYWORDS:** sensor trainer, DOST TEEPS, technology evaluation, feasibility, user perception

## 1. INTRODUCTION

Sensors play a critical role in factory automation, making systems more intelligent. They are used to detect various physical phenomena, such as sound, movement, and magnetic impulses, which are vital for modern industrial operations (Fahmy et.al, 2023). With the improvement of technologies, sensors became more prominent. Factories and manufacturing industries are now relying on different sensors for faster and minimal errors on their products. These advancements are very crucial in the near future where we are going.

  

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In higher educational institutions offering technology programs, teaching and learning sensor technology remains a significant challenge due to the lack of appropriate tools, equipment, and instructional trainers that support practical, hands-on learning. Nogas (2025) highlights that instructor in technical fields often encounter limitations related to the availability and adequacy of instructional equipment, which adversely affects both student performance and instructional quality. Moreover, the existing trainer currently available in the institution is not specifically aligned with the sensor technology curriculum as stipulated in CHED CMO No. 13, s. 2023. Its complexity and high cost further hinder its effective use in classroom settings. Consequently, many institutions, including ASSCAT, have begun integrating cost-effective, modular trainers designed to facilitate experiential learning. These devices provide students with opportunities to engage in real-world applications involving sensors and actuators, allowing the students to understand system integration and interpret sensor-generated data for use in automated control processes.

With the rapid advancement in automation and control systems, the integration of sensor technology in educational training is essential. The ELX 213 course under the Electronics Technology Program at Agusan del Sur State College of Agriculture and Technology (ASSCAT) seeks to equip students with hand-on experience using both microcontroller and PLC-based sensor applications (Dioso & Gumpal, 2024). However, existing instructional tools often fall short in bridging basic sensor concepts with industrial automation contexts, limiting student exposure to real-world sensor interfacing techniques.

To address the gap, a sensor technology trainer was developed and evaluated not only for technical performance but also for its overall acceptability based on national assessment standards. The trainer used Arduino UNO and Arduino Opta PLC platforms, making it possible for students to implement sensors in academic and semi-industrial environments. The use of two platforms is indicative of the increasing need for adaptive and expandable learning devices in technical education (Petrunin & Tang, 2023).

When evaluating such technologies, it is important to consider their acceptability and feasibility from a variety of angles. The Technology Evaluation and Ex-Post Prioritization System (TEEPS) was developed by the Department of Science and Technology (DOST) as a methodical framework for assessing innovations that are locally produced. Technical viability, economic and financial viability, environmental soundness, political acceptability, and social acceptability are its five primary components (DOST, 2005).

Prior research, such as that of Bermundo (2022), emphasizes the necessity of assessing trainer systems for usability, affordability, and social applicability in addition to functionality. Similarly, the CHED guidelines (CMO No. 13, s. 2023) support outcome-based learning that integrates appropriate teaching resources to meet community needs as well as curriculum goals. These observations remind us of the necessity of testing educational devices with holistic and standardized evaluation criteria.

In order to demonstrate the trainer's compliance with academic criteria and its viability for institutional adoption, this study used the DOST TEEPS framework to examine user evaluations of the trainer's efficacy.

## 2. METHODOLOGY

### 2.1 Research Design and Type

This study employed a descriptive research approach, which is suitable for collecting quantitative data from a selected population, to examine views, opinions, and degrees of acceptability. Investigating the user perceptions of the developed Sensor Technology Trainer, utilizing the five-point DOST Technology Assessment Protocol (TEEPS) framework, was the main objective. This setup allowed the researchers to experimentally collect and assess feedback without altering any of the factors while measuring the trainer in its natural instructional setting. Previous studies that have used the TEEPS framework to assess technical and pedagogical breakthroughs, such Zuraek's (2022) work, support its relevance in this context.

### 2.2 Research Locale and Duration

One of the colleges in the Caraga Region that provides a Bachelor of Industrial Technology with a focus on Electronics Technology is Agusan del Sur State College of Agriculture and Technology (ASSCAT), which is situated in Bunawan, Agusan del Sur, Philippines. The investigation was carried out there between January and April of 2025, a period of four months. The location was chosen because it actively offers the ELX 213-Sensor Technology course and because there is a growing need for current, practical teaching resources to promote outcomes-based technical education.

### 2.3 Participants and Sampling

The participants consisted of 40 respondents. This included 30 students currently enrolled in electronics technology, who had hands-on interaction with the trainer during laboratory activities. In addition, 10 faculty members and/or technical experts from electronics related fields were selected to represent professional and instructional perspectives. Their combined input guaranteed a fair assessment that took into account both expert opinion and learner experience.

To select individuals with specific knowledge relevant to the study's objectives, purposive sampling was employed. As Tongco (2007) noted, purposive sampling is particularly effective when researchers are seeking informants with specialized knowledge in a certain topic. According to Campbell et al. (2020), purposive sampling also enhances methodological rigor by aligning participant selection with the goals and environment of the study, which raises the validity of the findings in technical and applied educational research settings.

### 2.4 Inclusion and Exclusion Criteria

The count was limited to individuals who successfully finished the practical training session with the assigned trainer. To guarantee that the responses were pertinent and consistent, those who did not engage directly with the gadget were not included.

### 2.5 Research Instrument

Technical feasibility, economic and financial viability, environmental soundness, political acceptability, and social acceptability were the five categories that were evaluated using a structured questionnaire with a five-point Likert-scale that was based on the DOST Technology Evaluation and Ex-Post Prioritization System (TEEPS).

### 2.6 Data Collection

The data was gathered using a standardized questionnaire that used a 5-point Likert scale, where 1 represents no acceptability and 5 represents very high acceptability. The questionnaire was presented to the participants right after they had a face-to-face conversation with the trainer in a lab environment. The five TEEPS criteria that were discussed are technical feasibility, economic and financial viability, environmental soundness, political acceptability, and social acceptability. The Sensor Technology Trainer was introduced to them following a quick orientation. Then, following a hands-on exercise with the device, they were required to fill out the assessment form. Moreover, to ensure informed responses, each item was explained.

### 2.7 Data Analysis

To characterize participant responses and determine levels of acceptability, descriptive measures such as mean, standard deviation, and frequency were used, which is appropriate for descriptive research (Ary et al., 2010).

Additionally, descriptive statistics were used to evaluate user opinions and estimate acceptance levels in concurrent research evaluating educational trainers (Bermundo, 2022).

The data collected for this study was analyzed using descriptive statistical methods, which included mean, frequency distribution, and standard deviation for each TEEPS domain. The mean ratings were described using qualitative descriptions corresponding to the Likert scale (for example, 4.21-5.00 indicate Very High Acceptability). Standard deviation values were used to evaluate answer consistency, while frequency distributions were utilized to find trends and patterns in user evaluations. The study aimed to assess the

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trainer's acceptance and overall user satisfaction.

## 3. RESULTS AND DISCUSSION

The developed Sensor Technology Trainer was assessed using the DOST Technology Assessment Protocol's (TEEPS) five primary dimensions: technical feasibility, economic and financial viability, environmental soundness, political acceptability, and social acceptability. This section provides a detailed analysis of the descriptive statistics and user response patterns, emphasizing significant trends and implications for the use of education.

### 3.1 Overview of Descriptive Statistics

With mean values regularly ranging from 4.49 to 4.70 on a 5-point Likert-scale, the trainer received quite positive feedback overall from all five evaluation areas. Table 1 shows the summary of the mean scores and standard deviations for each domain. This reflects a generally "High," to "Very High," level of acceptability.

**Table 1: Descriptive Statistics (Mean and Standard Deviation per Domain)**

| *TEEPS Domain* | *Mean* | *SD* | *Interpretation* |
|---|---|---|---|
| Technical Feasibilty | 4.56 | 0.42 | Very High Acceptability |
| Ecomonic & Financial Viability | 4.49 | 0.38 | High Acceptability |
| Environmental Soundness | 4.67 | 0.35 | Very High Acceptability |
| Political Acceptability | 4.51 | 0.41 | Very High Acceptability |
| Social Acceptability | 4.70 | 0.30 | Very High Acceptability |

The results underscore a holistic perception of the trainer as being pedagogically relevant, economically sound, environmentally non-threatening, and aligned with policy and social contexts.

### 3.2 Technical Feasibility

Participants gave high scores to items addressing the safety, usability, and design of the trainer. Specific items such as “Trainer is safe to use”, “Emergency stop button is functional”, and “Trainer uses quality components” consistently received ratings of 4 and 5. The relatively low standard deviation (0.42) suggests a strong consensus among participants.

Moreover, integration of both Arduino UNO and Arduino Opta PLC platforms provides a dual-mode functionality that supports both academic and semi-industrial learning applications. This hybrid approch enhances the realism of training scenarios and exposes learners to industry-relevant systems.

**3.3 Economic and Financial Viability**

This domain falls in the "High Acceptability" range even though its mean score is the lowest—4.49. Well rated items like "Trainer is affordable to students" and "Maintenance and repair are easy to perform" show that cost issues are minor but existent. Particularly among student respondents, slightly higher variance in scores here points to different personal standards for affordability. This suggests possible areas of cost control without sacrificing performance. Fascinatingly, faculty members tended to score this domain somewhat higher than students, maybe because of their larger awareness of instructional budgets and equipment costing. The results suggest that institutional funding or cost-sharing schemes could help to guarantee accessibility.

**3.4 Environmental Soundness**

This dimension garnered one of the highest average scores (4.67), emphasizing the trainer's alignment with environmental sustainability principles. Items such as "No hazardous effect to humans or animals" and "Trainer components are reusable and recyclable" were strongly agreed upon. The use of low-power components and non-toxic materials enhances the trainer's compatibility with eco-conscious education goals.

Moreover, the trainer's design avoids unnecessary complexity and minimizes electronic waste, making it suitable for repeated instructional use with minimal environmental burden.

**3.5 Political Acceptability**

Political acceptability was measured through compliance with institutional and governmental standards, including safety, curricular alignment, and procurement feasibility. The high score (4.51) in this area suggests that the trainer meets CHED's outcome-based education requirements and institutional quality assurance policies.

Respondents affirmed that the trainer aligns with the ELX 213 course outcomes, including sensor calibration, digital interfacing, and process automation simulation. Such alignment supports administrative decisions toward procurement and curriculum integration.

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### 3.6 Social Acceptability

The highest mean score was recorded in this domain (4.70), emphasizing the trainer's inclusive, user-centered design. Items like "Usable by both sexes", "Trainer serves the needs of the majority", and "Trainer can be used in different learning environments" received overwhelmingly positive responses.

The trainer's portability, ease of use, and bilingual instruction manual contribute significantly to its social relevance. It also aligns with the goals of inclusive education and gender sensitivity, critical priorities in current pedagogical frameworks.

### 3.7 Response Frequency Analysis

A visual breakdown of the response frequencies across Likert scale levels reinforces the quantitative interpretations above. More than 90% of responses fell in the "4" (High Acceptability) and "5" (Very High Acceptability) categories, with minimal to no responses in the "1" (Very Low Acceptability) or "2" (Low Acceptability) ranges. This strongly suggests that the observed means are not skewed by outliers or irregularities.

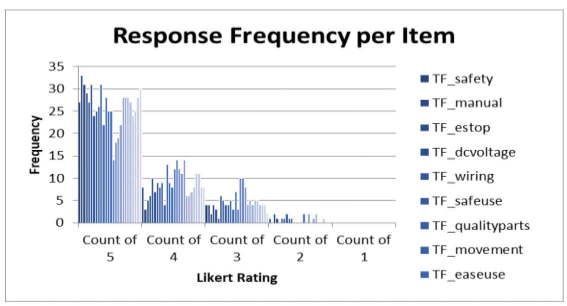


**Figure 1**: Response Frequency per Item

In technical feasibility, most respondents rated items such as "Safety precautions are indicated" and "Trainer is safe to use" with a  score of 5, reflecting strong agreement with the trainer's structural and operational reliability. Items related to portability received slightly more varied responses, ranging between 4 and 5, possibly due to individual handling experiences.

For economic and financial viability, ratings clustered around 4, especially for "affodable to end-user" and "Maintenance is simple". This suggests the trainer is greatly viewed as cost-effective, with room for slight improvements in cost efficiency.

Furthermore, for environmental soundness, responses skewed overwhelmingly toward 5 for items such as "No threat to environment" and "No hazardous effect to humans or animals", showing consensus on the ecological compatibility of the trainer.

With political acceptability, respondents rated this domain highly, particularly the item "Trainer meets regulatory standards", indicating that the device aligns with institutional and curricular requirements. As for social acceptability, this domain received the highest concentration of 5s, especially for "Usable by both sexes" and "Trainer serves the needs of the majority", reinforcing the trainer's inclusivity and social relevance.

Few to no responses fell within the lower ranges (1-2), which affirms strong overall acceptability. These findings support this integration of the trainer into the ELX 213 course and its potential use in similar technology programs.

**3.8 Comparison with Other Studies**

The findings of this study are consistent with earlier research on the developent and deployment of instructional trainers in engineering and technology education. Bermundo (2022) reported high levels of student engagement and satisfaction through the use of a low-cost, locally developed audio amplifier trainer. His results emphashized the critical role that affordable and context-specific devices play in enhancing hands-on instruction, particularly in electronics-based subjects.

The challenges were also identified and reported by Mercader and Gairin (2020), who highlighted that faculty adoption of educational technology is heavily influenced by academic discipline, institutional culture, and support mechanisms. In sensor technology, which is highly technical and equipment-dependent, these barriers become even more pronounced. Atabek (2019) further suppported this perspective by identifying infrastructure gaps and insufficient pedagogical training as key obstacles to technology integration. These issues mirror the difficulties faced by institutions like ASSCAT, which the developed Sensor Technology Trainer aims to resolve by providing a practical, affordable, and targeted solution for hands-on sensor instruction.

Nogas (2025) also documented the difficulties encountered by instructors in higher eductaion institutions, particularly the lack of appropriate tools and equipment in technical fields such as automotive and electronics technology. His study concluded that these limitations hinder both instructional effectiveness and student performance—challenges that the Sensor Technology Trainer developed in this study directly addresses. The favorable acceptability ratings, particularly in technical feasibility and social relevance, affirm the trainer's capacity to bridge these gaps.

Fahmy et al. (2024), in their work on Industrial Applications of Sensors, argued for the necessity of real-

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world exposure to sensor-based systems in order to equip students with essential skills in process automation and system integration. The trainer presented in this study supports this notion by enabling learners to work with real sensors in both microcontroller (Arduino UNO) and programmable logic controller (Arduino Opta) environments, simulating both educational and industrial applications.

Further supporting these conclusions, Suarez et al. (2023) investigated the impact of mobile robot platforms in engineering learning environments. Their results proved that experiential platforms greatly enhance student's conceptual understanding, hands-on skills, and motivation. As with this trainer, such platforms facilitate the transition of theoretical concepts into practical applications, thus enhancing learning outcomes in technical education.

Sanei et al. (2023) also developed the Low-cost Efficient Wireless Intelligent Sensor (LEWS) platform to reduce the cost of sensor technologies for engineering research and education. Their initiative emphasizes the benefits of low-cost, plug-and-play sensor systems for teaching advanced technical material, which is quite similar to the goals of the current study. The two projects serve to fulfill the growing demand for low-cost, scalable solutions that allow students to experiment with system architecture and real-time data collection.

When taken together, the findings show that incorporating sensor-based, experiential learning resources into engineering and technology education is both necessary and successful, especially in low-resource contexts. The Sensor Technology Trainer's positive adoption and detailed evaluation in this study demonstrate that it meets both the practical requirements of modern technical education and its educational goals.

### 3.9 Significance of the Findings

The findings confirm the trainer's possibility for institutional acceptance. It supports practice-based learning and satisfies competency-based targets set by CHED. Its modular design also lets one expand or customize to fit senior-level projects or specialized courses. It served as a practical model for how localized, low-cost educational innovations can support curriculum delivery even in resource-constrained contexts.

Additionally, given its favorable evaluation, the trainer can be considered for scaling across other institutions within the region, especially in resource-constrained settings where cost-effective yet functional instructional tools are urgently needed.

## 4. Conclusion

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The development and evaluation of the Sensor Technology Trainer demonstrated that the device is highly acceptable and effective instructional tool for teaching sensor-based automation in the ELX 213 course. Through the lens of the DOST TEEPS framework, the trainer received very high acceptability ratings across technical, environmental, political, and social dimensions, and high acceptability in economic and financial viability. These findings reflect the trainer's structural reliability, safety features, ease of use, environmental sustainability, and alignment with national educational policies, particularly CHED CMO No. 13, s. 2023.

The results affirm that the trainer fills a critical instructional gap in many higher education institutions offering technology programs, especially those that lack access to industrial-grade tools and resources. The trainer gives students practical learning experiences and improves their proficiency with microcontroller- and PLC-based systems by combining the Arduino UNO and Arduino Opta PLC platforms. These characteristics strengthen the trainer's value as a platform for industrial application preparation as well as in academic settings by closely matching current industry practices.

This study supports the growing significance of inexpensive, locally produced trainers that bridge the gap between theory and practice when compared to similar studies (e.g., Bermundo, 2022; Suarez et al., 2023; Sanei et al., 2023). A scalable, useful, and inclusive approach to teaching sensor technology is the trainer, created in this study.

It is highly advised that technology education programs implement the Sensor Technology Trainer in light of these findings. It can serve as a model for other institutions seeking to implement cost-effective, outcome-based, and hands-on learning tools. Future work may involve refining the trainer based on user feedback, expanding its application to other technical courses, and conducting longitudinal studies to assess its long-term impact on student performance and employability.

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