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EZBUY: A School Supply Vending Machine

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ABSTRACT: EZBUY is a school supply vending machine designed to improve access to basic academic materials at North Eastern Mindanao State University Cantilan Campus. It provides a self-service platform for students and faculty to purchase items like pens and paper. The system combines modular hardware, a coin-operated payment mechanism, controlled item dispensing, and a web-based administration panel for inventory and transaction monitoring. Developed using surveys and observations, EZBUY was evaluated under ISO 25010 standards and showed reliable performance. The system enhances convenience, reduces staff workload, and supports future scalability through expanded payment and cloud features.

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KEYWORDS: Vending Machine; School Supplies; Automated System; Campus use; Students and Faculty; Coin-Operated Payment; Inventory Management; Transaction Logging; Software Quality Evaluation; ISO 25010

I. INTRODUCTION

One of the key problems addressed in this study is the inconvenience faced by students and teachers at NEMSU Cantilan in obtaining school supplies due to the absence of a centralized and automated system. Long queues and the need to travel to off-campus stores, especially during urgent situations, result in time loss and reduced academic productivity. The lack of an on-campus, quick-access facility increases dependence on external shops that may be unavailable during class hours.

Although vending machines have evolved from basic microcontroller-based systems into IoT-enabled platforms with real-time monitoring and cashless transactions, many still lack a focus on sustainability and academic needs. Most existing systems cater to general consumer products and offer limited support for environmentally responsible practices. This creates a gap in providing accessible, efficient, and sustainable solutions specifically designed for school environments.

To address these concerns, the researchers developed EZBUY: A School Supply Vending Machine. EZBUY offers a fast, self-service method for acquiring essential school materials on campus, promoting convenience and efficiency. By providing ready-to-use supplies and emphasizing sustainability, the system ensures round-the-clock access while supporting the academic needs of the NEMSU Cantilan community.

II. LITERATURE SURVEY

An analytical review of existing literature on supply management in the campus, as well as the development of automated vending systems, is needed to place the current study in the contemporary technology-driven paradigm. With the need for access to school supplies intensifying for students, many academic institutions are finding ways to shift from the conventional manual approach to the modern computerized, autonomous system. For institutions such as NEMSU Cantilan, the most effective system would prioritize the timely, efficient, and convenient access of essential supplies. The most effective system would integrate the replacement of the manual system for supply distribution with a computerized system that provides capabilities for fully automated dispensing, up-to-date inventory monitoring, as well as convenient payment processing. Although some existing literature on the matter provides insights on the challenges such as lengthy queues, unpredictable inventory, and processing bottlenecks, the solution is still needed in addressing the two aspects of efficiency in supply management in the campus.

Vending machines have evolved from simple dispensing devices into strategic systems that meet modern consumer expectations. Consumer perceptions commonly focus on product safety, health promotion, and policy compliance, especially during global health crises like COVID-19 [1]. These insights show that safety concerns strongly influence user evaluations of vending system reliability. Overall, the findings highlight how consumer trust and technological innovation drive vending machine adoption in contemporary settings.

The use of vending machines in academic environments continues to grow as schools seek better access to essential learning materials. School supply vending machines provide convenient, time-saving solutions for students and faculty, while system reliability, consistent maintenance, and strong coordination among developers and administrators are essential to prevent stock errors and mis-dispensing [2]. These findings underscore that technical stability and institutional support are critical for successful implementation in educational settings.

Vending machines contribute significantly to academic preparedness, especially in underserved school communities. Machines providing notebooks, pens, and hygiene kits reduce barriers to essential materials, and their availability beyond regular store hours supports continuous learning by ensuring constant access to needed supplies [3]. These findings illustrate how well-designed school supply vending machines promote educational equity and improve student performance.

User satisfaction strongly influences the effectiveness of vending systems in academic institutions. While vending machines offer convenience, students often cite high prices and limited product variety as concerns, which can reduce

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perceived usefulness despite time savings and on-campus accessibility [4]. Therefore, improving affordability, expanding item selection, and enhancing user-centered design are essential to boost overall satisfaction.

Environmental sustainability has become a key issue in university vending machine operations. Many machines lack eco-friendly school supplies and sustainable packaging, limiting opportunities to promote responsible consumption. Financial and contractual constraints often hinder institutions from sourcing greener materials, and addressing these barriers can create vending systems that support both environmental responsibility and student needs [5].

Table 1. Summary of Relevant Literature

No.	Paper Title	Author Name	Key Points	Remarks
1	The role of vending channels in marketing	Stoyanov (2021)	Consumer trust is influenced by product safety, health standards, and policy compliance, especially during health crises.	Highlights the role of safety and innovation in vending machine adoption.
2	Examining the evolution and impact of OTC vending machines in global healthcare systems	Jairoun et al. (2024)	Vending machines provide convenient and time-saving access to school supplies for students and faculty.	Emphasizes the importance of system reliability and institutional support.
3	Vending machines for reducing harm associated with substance use and use disorders, and co-occurring conditions	Zhang et al. (2025)	School supply vending machines reduce barriers to essential materials and support continuous learning.	Shows positive impact on educational equity and student readiness.
4	Consumption, attitudes, and trends of vending machine foods at a university campus	Hasan et al. (2021)	Convenience is valued, but high prices and limited product variety reduce user satisfaction.	Suggests improving affordability and user-centered design.
5	Assessment of the sustainable level of vending machine products in an Italian university	Bertossi et al. (2023)	Many vending machines lack eco-friendly products and sustainable packaging.	Identifies the need for greener practices despite financial constraints.

In summary, the literature shows that vending machines play an important role in improving access to school supplies in academic settings. User trust, convenience, reliability, affordability, and product variety influence acceptance and satisfaction. Despite their benefits, challenges such as sustainability and maintenance remain, highlighting the need for a reliable and user-centered system like EZBUY.

III. METHODOLOGY

Research Design

The researchers employed a Descriptive Developmental Research approach, guided by the Agile Model of the Software Development Life Cycle (SDLC). This methodology emphasized an iterative workflow, enabling continuous refinement and enhancement of the system based on user feedback. Instead of manipulating experimental variables, the study concentrated on the systematic development of EZBUY: A School Supply Vending Machine and assessed its effectiveness through standardized performance metrics within the real-world environment of North Eastern Mindanao State University – Cantilan Campus.

Instrument

To assess the quality of the developed system, a survey based on the ISO/IEC 25010 Software Quality Model was employed. The evaluation tool used a five-point Likert scale to collect data on key software attributes, including

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Functional Suitability, User Interface/Usability, Reliability, and Portability. Each item in the questionnaire was specifically designed to measure how effectively EZBUY digitizes and streamlines access to school supplies, providing a convenient self-service alternative to traditional manual purchasing methods on campus.

Data Collection and Participants

Data was gathered from a purposive sample of 50 respondents within the NEMSU Cantilan community. The participant pool consisted of 25 student end-users from various departments, 15 IT practitioners, and 10 IT experts and administrative personnel. Before completing the evaluation, all participants were provided with a comprehensive walkthrough and live demonstration of the EZBUY vending machine, including the product selection process, coin-based payment system, and automated dispensing mechanism, ensuring they fully understood the system's features and operations.

Data Analysis

The quantitative data gathered from the evaluation of EZBUY were analyzed using the following statistical treatments:

1. **Weighted Mean:** Calculated to determine the average performance rating for each software quality attribute based on the ISO/IEC 25010 standard.
2. **Qualitative Interpretation:** Mean scores were classified into descriptive levels (e.g., 4.21 – 5.00 as "Great Extent") to assess overall user satisfaction and system acceptance.
3. **Performance Verification:** Systematic testing of the vending machine's dispensing accuracy, payment processing, and operational speed to ensure reliable performance under real campus conditions.
4. **Usability Assessment:** Evaluation of the system's interface, ease of navigation, and user interaction to verify that students and staff can efficiently access and use EZBUY without difficulty.

IV. RESULTS AND DISCUSSION

System Features

The analysis of system performance and user feedback indicates that EZBUY effectively meets the technical and operational requirements of North Eastern Mindanao State University – Cantilan Campus. By providing a digital self-service platform for school supplies, the system streamlines access and reduces reliance on manual purchase methods.

1. **Metric-Based Evaluation:** Data collected using the ISO/IEC 25010 framework shows excellent results, with the system attaining a total mean of 4.02, corresponding to a verbal interpretation of "Great Extent." This indicates that EZBUY exceeds benchmarks for functional quality, usability, and overall adoption within the campus.
2. **Reliability and Consistency:** Categories such as Reliability (4.05) and Functional Suitability (4.04) emerged as the strongest attributes, demonstrating that the system consistently dispenses products accurately and operates smoothly without technical interruptions.
3. **Process Optimization:** Feedback from students, faculty, and administrative staff highlighted a significant reduction in time spent obtaining school supplies. The automated vending process eliminates queues and manual handling, while the clear user interface and simple payment mechanism ensure efficient transactions.
4. **User Acceptance:** The high rating for Usability (4.05) confirms that EZBUY's features product selection, coin-based payment, and automated dispensing are highly relevant and convenient for daily campus use. Respondents agreed that the system improves accessibility and overall satisfaction compared to traditional purchasing methods.

Table 2. Performance Evaluation System Tabulation

Table	Quality Characteristics	Mean	Verbal Interpretation
1	Functional Suitability	4.04	Great Extent
2	Performance Efficiency	4.04	Great Extent
3	Compatibility	3.90	Moderate Extent
4	Usability	4.05	Great Extent
5	Reliability	4.05	Great Extent
6	Maintainability	4.00	Great Extent
7	Portability	4.05	Great Extent
	Over-All Mean	4.02	Great Extent

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V. CONCLUSION

The EZBUY: A School Supply Vending Machine provides students and faculty with a quicker, more convenient way to purchase needed school supplies on campus. The system eliminates manual processes for product selection, payment, and dispensing, ensuring accurate transactions and efficient inventory tracking. It saves time and effort for both users and administrators compared to traditional methods. Thus, EZBUY offers an innovative solution for accessibility, efficiency, and reliable school supply management at NEMSU Cantilan Campus.

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