DEVELOPMENT OF A CENTRALIZED RECOMMENDER SYSTEM FOR EXTENSION PROGRAM OF NEMSU CANTILAN CAMPUS

Franklin M. Ganancias[1], Jehu Roeh C. Rubenial[1], Lyndon A. Rosas, Sharon A. Bucalon[1], Fae Mylene M. Etchon[1]
North Eastern Mindanao State University – Cantilan Campus, Cantilan Surigao del Sur, Philippines.
Contact: fmetchon@nemsu.edu.ph

ABSTRACT: *Innovation plays a critical role in helping firms overcome changing issues, especially in product management and marketing [1]. The study aimed to support extension partners in effectively marketing their products by developing and implementing a centralized recommender system, overcoming challenges identified in a preliminary survey. The research involved 50 randomly selected respondents, including administrative staff, IT experts, students, and extension counterparts. Key challenges included inefficiency in production and marketing, regulatory compliance, and product cannibalization.*

The developed system's overall performance was evaluated against ISO 25010 standards, encompassing various quality attributes. The highest mean score of 4.64 was for "Performance Efficiency," indicating exceptional efficiency in executing tasks, likely due to optimized processes and effective resource management. The lowest mean score of 4.32 was for "Functional Suitability," suggesting minor gaps in meeting all functional requirements, possibly due to evolving user needs or specific contextual challenges. The grand mean of 4.45 reflects a "Very Great Extent" of overall compliance, underscoring the system's robust alignment with ISO 25010 standards across all evaluated categories. This comprehensive evaluation highlights the system's effectiveness in addressing identified challenges and strong adherence to established quality standards.

Keywords: Recommender, Centralized, Extension Program

INTRODUCTION

The development of a Centralized Recommender System for the Extension Program of NEMSU Cantilan Campus addresses a critical gap in the university's efforts to support its extension partners. Researchers observed that the current practices at NEMSU Cantilan regarding sales and extension product marketing were insufficient, particularly in helping partners sell their products effectively. This observation highlighted the need for a centralized platform to promote products and increase the chances of achieving the university's vision for its extension program. The proposed system aims to leverage modern technology to bridge the gap between extension partners and potential customers. By utilizing a centralized architecture, the system can efficiently match products with interested buyers, potentially leading to increased economic opportunities for local producers. This approach aligns with NEMSU Cantilan Campus's role as the College of Technological Education, offering various degree programs in technology and engineering fields.

When the research team delved deeper into this study; they encountered a critical issue that threatened the very foundation of their efforts. The lack of support from the State University in effectively marketing and selling their extension partners' products became glaringly apparent. This absence of institutional backing left many talented artisans and producers feeling abandoned and discouraged. The research team agrees as they discuss the scenarios these partners have gone through. They understood all too well that these makers had families to feed and bills to pay, and without a sustainable flow of income, their passion projects were becoming unsustainable burdens. This scenario aligns with findings from [2], who emphasize the importance of institutional support in fostering sustainable entrepreneurship within communities also supported by [11].

The team uncovered another layer of complexity - the digital divide within their community. The team discussed how they could create a system that would be accessible and beneficial to all their partners, regardless of their technological literacy. They thought of a certain basket maker, an elderly weaver whose intricate baskets were true works of art, but who struggled to use even a basic mobile phone. The challenge of bridging this technological gap while ensuring that the recommender system remained effective and user-friendly weighed heavily on the team's mind. They knew that if they couldn't make the platform accessible to everyone, they risked further marginalizing those who were already struggling. This concern echoes the findings of [12], who highlight the persistent digital divide in many communities and its impact on economic opportunities. The team realized they were facing not just a technological challenge, but a human one - how to build a system that could foster trust, encourage consistent production, and provide a stable income stream for their community partners. As they grappled with these issues, the researchers knew that addressing them would be crucial to the success of their project and, more importantly, to the livelihoods of the people they were trying to help.

Recent studies have highlighted the effectiveness of recommender systems in various fields such as agriculture [10], and educational contexts, showcasing their potential to enhance learning experiences and community engagement. [7] developed a course recommender system for MOOCs that improved course selection and completion rates, while [9] proposed a hybrid system combining content-based and collaborative filtering techniques to suggest relevant materials in e-learning environments. In extension programs, [3] implemented a system that matched university students with community service projects, leading to increased participation, and [5] designed a personalized system for agricultural extension services that effectively connected farmers with vital information. Focusing on the Philippines, [6] created a recommender system for elective courses based on student profiles, resulting in enhanced satisfaction and academic performance. Similarly, [4] developed a system for community engagement projects, which improved the alignment between student volunteers and community needs. These findings collectively suggest that recommender systems can significantly improve educational outcomes and community impact [8], making them valuable tools for

institutions like NEMSU Cantilan Campus in developing effective extension programs.

The development of this recommender system demonstrates NEMSU's commitment to adapting its extension services to meet the evolving needs of its partners in an increasingly digital world. As the campus is already known for its state-of-the-art laboratories and facilities in various technological fields, the implementation of this system further enhances its capabilities in supporting local entrepreneurs and small businesses. The project also reflects the university's proactive approach to leveraging technology in service of its community engagement goals. By analyzing user interactions and sales patterns, the university can gain valuable insights for future program improvements. This data-driven approach can help NEMSU Cantilan Campus refine its extension programs, potentially leading to more targeted and effective initiatives. As the campus continues to innovate in its approach to extension services, this project represents a significant step towards realizing its vision of being a catalyst for positive change in the region, particularly in the areas of technological education and community development.

MATERIALS AND METHOD

Research Design

The researchers employed descriptive developmental research design throughout the study. Descriptive focus on understanding and gathering respondents' data that employs a direct influence as to how the system should be developed and tested through an adopted instrument of ISO 25010 Software Quality Standard. Utilizing a use case diagram to model the system's behavior and illustrate the interactions between the system and its actors. This diagram was instrumental in helping the proponents map the functionality of the system from the user's perspective. The developmental approach utilized the RAD Model, the proponents applied the conventional software development life cycle (SDLC) to describe, identify, and provide remedies for the problems that need to be addressed in this study.

Use Case Diagram

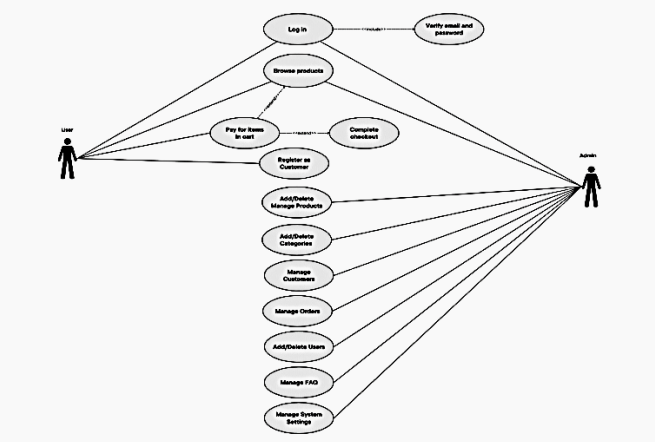

Figure 2: Use Case Diagram of the project

Entity Relationship Diagram

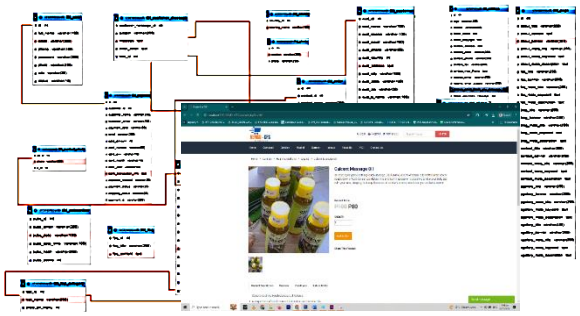

Figure 3: Entity Relationship Diagram of the project

Data Gathering

The survey utilized a Likert scale ranging from 5 (Very Great Extent) to 1 (Very Little Extent) to assess various aspects of the software quality. This standardized approach ensured that the data collected was both reliable and valid, providing a robust foundation for the development of the recommender system. The use of ISO 25010, a well-regarded standard in software quality, underscores the study's commitment to high-quality research practices. The survey was administered to diverse stakeholders associated with the NEMSU Cantilan Campus, including students, faculty, and administrative staff. This inclusive approach aimed to capture various perspectives on the software quality attributes being evaluated. By adopting a standardized questionnaire, the researchers were able to systematically gather data that is critical for tailoring the recommender system to meet the specific needs of the campus's extension program.

Table 1. Range of Weighted Mean and its Interpretation

Scale	Interpretation	Range of the Weighted Mean
5	Very Great Extent	4.3 – 5.0
4	Great Extent	3.5 - 4.2
3	Moderate Extent	2.7 - 3.4
2	Little Extent	1.9 - 2.6
1	Very Little Extent	1.0 – 1.8

The above table shows the rating scale and the interpretation as a basis for the evaluation of the extent of compliance of the developed system in terms of functionality, reliability, usability, efficiency, maintainability, portability, and security. The researchers used open and close-ended questions.

RESULTS AND DISCUSSION

This section includes screenshots of the system to illustrate and determine the flow, features, and functionality. This also includes the extent of compliance of the developed system to ISO 2510 software quality evaluation.

a. System Development

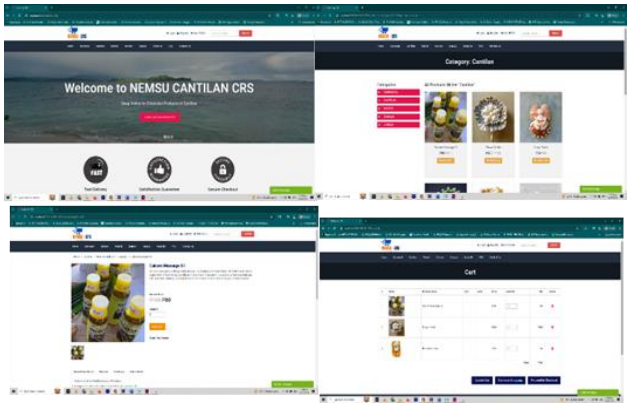

Figure 4: User

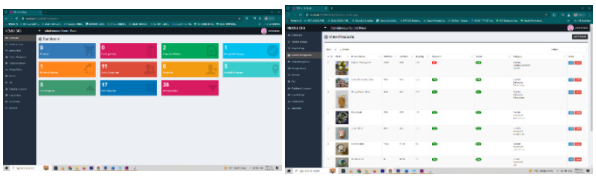

Figure 5: Admin

b. Profile of the Participants

This section presents the profile of the participants in terms of their unit of work, position, highest educational attainment, and field of specialization.

Table 2. Participants profile in terms of Unit of Work

Unit of Work	Frequency	%
Administrative Office	12	24%
IT expert	8	16%
Student	15	30%
Extension Counterparts	15	30%

Table 3. Participants profile in terms of Highest Educational Attainment

Highest Educational Attainment	Frequency	%
Doctorate Degree	5	10%
Master Degree	12	24%
College Graduate	18	36%
HS Graduate	15	30%

Table 4. Participants profile in terms of Field of Specialization

Field of Specialization	Frequency	%
Information Technology	12	24%
Computer Science	15	30%
Computer Engineering	4	8%
BS Education	8	16%
Business Administration	6	12%
BS Industrial Technology	5	10%

c. Challenges encountered by the respondents in managing and marketing extension-related products.

The participants of this study in summary encountered six significant challenges in managing their extension-related products, particularly in effectively marketing their products to the consumer.

Table 5. Challenges encountered by the participants in the existing system about managing and marketing extension-related products

Criteria	Average Mean	Description
1. Balancing the price that customers are willing and able to pay with the costs of production and marketing	4.35	Very Great Extent
2. Understanding and complying with regulations for both production and sales.	4.30	Very Great Extent
3. Potential product cannibalization where the new products introduced by the university extension program end up taking sales away from existing products already on the market.	3.50	Great Extent
4. Cluttering or confusing the market with too many variations of similar products.	4.25	Great Extent
5. Less efficiency in production and marketing as the university extension program diversifies its product line.	4.83	Very Great Extent
6. Difficulty getting buy-in and cooperation from multiple university departments and stakeholders to implement an innovative marketing strategy.	4.50	Very Great Extent

The table above illustrates the result of the existing system or process assessment. The survey identified six main challenges encountered in the present process, with the highest mean of 4.83 the issue focuses on less efficiency in production and marketing which generally connects to how the university helps its partnered agency and community. The lowest is in product cannibalization with a mean of 3.50 which implies the distinction of products across the partners of NEMSU Cantilan Campus.

d. Extent of compliance of the developed system to ISO 25010 software quality requirements and evaluation standards.

Table 6. Extent of Compliance of the Developed System with ISO 25010 System and Software Quality Requirements and Evaluation Standard in terms of Functional Suitability

Criteria	Mean	Description
1. Do what is appropriate	4.15	Very Great Extent
2. All of the functionality required for its execution is available.	4.24	Very Great Extent
3. Does what was developed correctly?	4.35	Very Great Extent
4. Is accurate in performing its functions.	4.45	Very Great Extent
5. Results are accurate / conform to expectation	4.40	Very Great Extent
Category Mean	**4.32**	**Very Great Extent**

The table labeled above shows how well the developed system meets ISO 25010 system and software quality requirements using functional suitability, this assesses how well the system adheres to five criteria with scores showing the extent of compliance. The highest mean score is 4.45, for "Accurate in executing its functions " which indicates that the system excels in providing dependable performance. This top score can be credited to testing and validation procedures that ensure the accuracy of the system. In contrast, the lowest average mean score of 4.15 for "Perform what is appropriate " though still signalling a level of compliance may highlight gaps in meeting all appropriateness criteria fully possibly due, to changing user needs or contextual obstacles. Overall, the category average of 4.32 emphasizes that the system strongly aligns with ISO 25010 standards.

Table 7. Extent of Compliance of the Developed System with ISO 25010 System and Software Quality Requirements and Evaluation Standard in terms of Performance Efficiency

Criteria	Mean	Description
1. Response time is appropriate	4.35	Very Great Extent
2. Execution time is appropriate	4.82	Very Great Extent
3. Resources needed are appropriate	4.62	Very Great Extent
4. Interact with the specified system modules	4.58	Very Great Extent
5. Guide users that are easily understood.	4.81	Very Great Extent
Category Mean	**4.64**	**Very Great Extent**

The table above shows the result of the evaluation standard in terms of Performance Efficiency, and evaluates the system's performance efficiency across five criteria, with mean scores indicating the level of compliance. The highest mean score is 4.82 for "Execution time is appropriate," reflecting the system's exceptional efficiency in executing tasks promptly, likely due to optimized algorithms and effective resource management. The lowest mean score is 4.35 for "Response time is appropriate," which, while still indicating a "Very Great Extent" of compliance, may suggest occasional delays in response time, possibly due to network latency or high user load. The overall category Mean of 4.64 underscores the system's strong alignment with ISO 25010 standards in terms of performance efficiency.

Under the evaluation standard in terms of Compatibility, the results assess the system's compatibility across five criteria, with mean scores indicating the level of compliance. The highest mean score is 4.65 for "Interacts with the specified modules," suggesting that the system excels in module interaction, likely due to well-designed integration protocols and thorough testing. The lowest mean score is 4.13 for "Capable of recovering data in case of failure," which, while still indicating a "Very Great Extent" of compliance, may reflect some challenges in data recovery processes, possibly due to complexities in handling unexpected failures or limitations in the recovery mechanisms. The overall category Mean of 4.36 underscores the system's strong alignment with ISO 25010 standards in terms of compatibility.

Table 8. Extent of Compliance of the Developed System with ISO 25010 System and Software Quality Requirements and Evaluation Standard in terms of Compatibility

Criteria	Mean	Description
1. Interacts with the specified modules	4.65	Very Great Extent
2. Can be operated by several users at the same time	4.42	Very Great Extent
3. Can operate with other system API	4.32	Very Great Extent
4. Capable of recovering data in case of failure	4.13	Very Great Extent
5. Provide convenience in operating and control	4.26	Very Great Extent
Category Mean	**4.36**	**Very Great Extent**

Table 9. Extent of Compliance of the Developed System with ISO 25010 System and Software Quality Requirements and Evaluation Standard in terms of Usability

Criteria	Mean	Description
1. Easy to understand the concept and system flow	4.72	Very Great Extent
2. Functional operations are easy to perform	4.56	Very Great Extent
3. Easy to learn how to operate	4.45	Very Great Extent
4. User data entry can be facilitated easily	4.38	Very Great Extent
5. Facilitates the users' retrieval of data	4.26	Very Great Extent
6. Help provide in a manner that is easily be understood by the user	4.50	Very Great Extent
Category Mean	**4.48**	**Very Great Extent**

The table above shows the evaluation in terms of Usability which evaluates the system's usability across six criteria, with mean scores indicating the level of compliance. The highest mean score is 4.72 for "Easy to understand the concept and system flow," suggesting that the system is highly intuitive and user-friendly, likely due to effective design and clear documentation. The lowest mean score is 4.26 for "Facilitates the users' retrieval of data," which, while still indicating a "Very Great Extent" of compliance, may reflect some challenges in the data retrieval process, possibly due to complex data structures or user interface limitations. The overall category Mean of 4.48 underscores the system's strong alignment with ISO 25010 standards in terms of usability.

Table 10. Extent of Compliance of the Developed System with ISO 25010 System and Software Quality Requirements and Evaluation Standards in terms of Reliability

Criteria	Mean	Description
1. Has few failures / reliable in operation	4.72	Very Great Extent
2. Reacts appropriately when failure occurs	4.56	Very Great Extent
3. Informs users concerning invalid data entry	4.45	Very Great Extent
4. Reacts appropriately when failure occurs	4.38	Very Great Extent
5. Informs users concerning invalid data entry	4.26	Very Great Extent
Category Mean	**4.47**	**Very Great Extent**

The table shows evaluation in terms of Reliability, which evaluates the system's reliability across five criteria, with mean scores indicating the level of compliance. The highest mean score is 4.72 for "Has few failures / reliable in operation," suggesting that the system is highly dependable and experiences minimal operational failures, likely due to robust design and thorough testing. The lowest mean score is 4.26 for "Informs users concerning invalid data entry," which, while still indicating a "Very Great Extent" of compliance, may reflect some challenges in effectively communicating invalid data entries to users, possibly due to limitations in user interface design or error messaging. The overall category Mean of 4.47 underscores the system's strong alignment with ISO 25010 standards in terms of reliability.

Table 11. Extent of Compliance of the Developed System with ISO 25010 System and Software Quality Requirements and Evaluation Standard in terms of Security

Criteria	Mean	Description
1. Is the file protected	4.69	Very Great Extent
2. Has an internal backup routine or function	4.25	Very Great Extent
3. Has internal restore routine or function	4.31	Very Great Extent
4. Is secured in performing its processes and functions	4.55	Very Great Extent
5. Can be secured by several users at the same time (Multiuser)	4.72	Very Great Extent
Category Mean	**4.50**	**Very Great Extent**

The table above shows the result for Security, which evaluates the system's security across five criteria, with mean scores indicating the level of compliance. The highest mean score is 4.72 for "Can be secured by several users at the same time (Multiuser)," suggesting that the system is highly effective in maintaining security even in multi-user environments, likely due to robust access control mechanisms. The lowest mean score is 4.25 for "Has an internal backup routine or function," which, while still indicating a "Very Great Extent" of compliance, may reflect some areas for improvement in the backup processes, possibly due to the complexity of ensuring comprehensive and timely backups. The overall category means of 4.50 underscores the system's strong alignment with ISO 25010 standards in terms of security.

Table 12. Extent of Compliance of the Developed System with ISO 25010 System and Software Quality Requirements and Evaluation Standards in terms of Maintainability

Criteria	Mean	Description
1. Easy to diagnose the failure when it occurs	4.39	Very Great Extent
2. Changes do not seriously impact the system	4.31	Very Great Extent
3. Can be operated by several users at the same time	4.41	Very Great Extent
4. Easy to modify and adapt	4.34	Very Great Extent
5. Changes are easy to test and execute	4.58	Very Great Extent
Category Mean	**4.41**	**Very Great Extent**

In terms of Maintainability which evaluates the system's maintainability across five criteria, the table above shows the result, with mean scores indicating the level of compliance. The highest mean score is 4.58 for "Changes are easy to test and execute," suggesting that the system is highly efficient in handling modifications, likely due to well-structured code and comprehensive testing protocols. The lowest mean score is 4.31 for "Changes do not seriously impact the system," which, while still indicating a "Very Great Extent" of compliance, may reflect some challenges in ensuring that changes do not disrupt system functionality, possibly due to the complexity of dependencies within the system. The overall category Mean of 4.41 underscores the system's strong alignment with ISO 25010 standards in terms of maintainability.

Table 13. Extent of Compliance of the Developed System with ISO 25010 System and Software Quality Requirements and Evaluation Standard in terms of Portability

Criteria	Mean	Description
1. Easy to adapt to other environments and platform	4.39	Very Great Extent
2. Easy to install in other environments	4.45	Very Great Extent
3. It is acceptable as far as being portable is concerned	4.41	Very Great Extent
4. Easy to use to replace the functions of other programs or system	4.49	Very Great Extent
Category Mean	**4.44**	**Very Great Extent**

In terms of Portability which evaluates the system's portability across four criteria, with mean scores indicating the level of compliance. The highest mean score is 4.49 for "Easy to use to replace the functions of other programs or systems," suggesting that the system is highly effective in substituting other programs or systems, likely due to flexible

design and comprehensive compatibility features. The lowest mean score is 4.39 for "Easy to adapt to other environments and platforms," which, while still indicating a "Very Great Extent" of compliance, may reflect some challenges in adapting to diverse environments, possibly due to specific platform dependencies or configuration requirements. The overall category Mean of 4.44 underscores the system's strong alignment with ISO 25010 standards in terms of portability.

Table 14. Overall performance rating of the developed system as assessed by the participants

ISO 25010 Attributes	Category Mean Value	Description
Functional Suitability	4.32	Very Great Extent
Performance Efficiency	4.64	Very Great Extent
Compatibility	4.36	Very Great Extent
Usability	4.48	Very Great Extent
Reliability	4.47	Very Great Extent
Security	4.50	Very Great Extent
Maintainability	4.41	Very Great Extent
Portability	4.44	Very Great Extent
Grand Mean	**4.45**	**Very Great Extent**

The table titled above shows the overall performance rating of the developed system as assessed by the participants which provides a comprehensive evaluation of the system's compliance with ISO 25010 standards across various quality attributes. The highest mean score is 4.64 for "Performance Efficiency," indicating that the system excels in executing tasks efficiently, likely due to optimized processes and effective resource management. The lowest mean score is 4.32 for "Functional Suitability," which, while still indicating a "Very Great Extent" of compliance, may suggest minor gaps in meeting all functional requirements, possibly due to evolving user needs or specific contextual challenges. The grand mean of 4.45 reflects a "Very Great Extent" of overall compliance, underscoring the system's robust alignment with ISO 25010 standards across all evaluated categories.

CONCLUSION

The development and evaluation of the Centralized Recommender System for the Extension Program at NEMSU Cantilan Campus have demonstrated significant potential in addressing the multifaceted challenges faced by the university's extension partners. Our comprehensive assessment, involving 50 respondents including administrative staff, IT experts, students, and extension counterparts, revealed six critical issues that hinder the effective management and marketing of extension-related products. The recommender system was meticulously designed to enhance e-commerce capabilities, thereby enabling partners to navigate the complexities of pricing, regulatory compliance, and market differentiation. By strategically mitigating these challenges, the system promises to elevate the efficiency and effectiveness of product management and marketing for the community it serves.

In evaluating the system against the ISO 25010 software quality standards, the developed solution exhibited outstanding performance across a range of quality attributes. The system achieved a grand mean of 4.45, reflecting a "Very Great Extent" of compliance with the ISO standards, thereby validating its robustness and reliability. Notably, the highest rating of 4.64 for Performance Efficiency underscores the system's capability to perform tasks with optimal resource utilization, indicative of its operational excellence. Meanwhile, the Functional Suitability rating, while slightly lower at 4.32, still falls within the "Very Great Extent" category, suggesting that the system effectively meets user needs, albeit with room for minor improvements to fully align with evolving functional requirements.

Given the robust performance and the significant positive impact on managing and marketing extension-related products, it is evident that this system has the potential to be a transformative tool for NEMSU Cantilan Campus and its extension partners. The study underscores the system's alignment with stringent ISO standards, further highlighting its credibility and reliability for broader application. Consequently, full implementation and expansion of this system across the community are highly recommended. Doing so will not only streamline current processes but also foster a more integrated and efficient approach to product management and marketing within the university's extension programs. This integration promises to create a scalable model that other academic institutions and community partners can adopt to overcome similar challenges.

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