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Development of Student Government E-Voting Application

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Abstract. This study underscores the transformative potential of an e-voting mobile application in enhancing the election process at NORSU-Guihulngan Campus by improving efficiency, reliability, and transparency. This innovative solution ensures a streamlined, fair, and secure electoral process by addressing the limitations of traditional manual voting systems. The descriptive-developmental method employed included planning, prototyping, testing, and data gathering. A survey was distributed to 106 respondents, including students and IT experts, to evaluate the manual voting system and assess the e-voting application's functionality. Pilot tests were conducted with criteria focusing on user interface, security, accessibility, transparency, and reliability, supported by statistical analysis. The e-voting application exhibited exceptional performance across all evaluated aspects. The user interface and security scored an average of 4.39, reflecting excellent design and robust data protection. Accessibility achieved the highest rating at 4.46, ensuring seamless usability for diverse users. Transparency and reliability were rated at 4.31 and 4.41, respectively, underscoring the system's openness and consistent functionality. Overall, the application achieved a total average rating of 4.39, confirming its effectiveness as a voting solution. The application's usefulness was evaluated across six key features: accessibility, time and cost efficiency, real-time results, enhanced accuracy, increased security, and audit trail transparency. Accessibility and real-time results received scores of 3.50, while time and cost efficiency achieved 3.60. Enhanced accuracy and security also scored 3.50, minimizing errors and fostering trust. Audit trail transparency, rated at 3.40, emphasized the system's accountability. These findings validate the application's ability to revolutionize student elections at NORSU-Guihulngan and provide a scalable model for similar institutional contexts. The study highlights the importance of integrating modern technology into election systems, paving the way for broader adoption in academic and institutional settings to ensure reliable and transparent processes.

Keywords: E-voting; Innovation; Student government; Technology.

1.0 Introduction

Traditional election processes, particularly in educational institutions, often struggle to meet the dynamic needs of modern voters. As a demographic, students had grown accustomed to digital interactions, which had become central to their daily lives. Despite the increasing shift towards digital solutions, many educational institutions relied on outdated manual voting systems for student government elections. This practice proved inefficient, prone to errors and failed to account for the diverse needs of the student body. At Negros Oriental State University – Guihulngan Campus (NORSU-Guihulngan), the existing manual voting system for student elections exemplified these challenges, resulting in administrative inefficiencies, low voter turnout, and a lack of inclusivity. This study aimed to address these challenges by proposing an innovative e-voting application explicitly tailored

for NORSU-Guihulngan. By introducing a secure, user-friendly, and transparent digital voting platform, the study sought to modernize and enhance the student election process, ultimately improving voter engagement, administrative efficiency, and the democratic integrity of the institution's governance.

Voting, as a cornerstone of democracy, was integral to the functioning of any democratic society. In the context of the Philippines, the importance of active participation in governance was enshrined in Article V of the Philippine Constitution, which emphasized the right to vote as a critical element of citizenship. This right was mirrored in educational institutions, where student government elections were vital for fostering democratic values, leadership skills, and civic engagement among students. Student government elections replicated the democratic processes seen in national elections and were vital to instilling the values of active citizenship. However, using traditional manual voting systems in many institutions, including NORSU-Guihulngan, presented significant drawbacks. In these traditional systems, voters were often required to cast ballots physically, and volunteers manually tallied election results. This process was time-consuming, prone to errors, and difficult to manage in large student populations. Additionally, manual voting systems often faced challenges such as voter disenfranchisement, particularly among students who faced logistical barriers such as limited time or mobility issues. These limitations had contributed to low voter turnout and diminished participation in student elections, further undermining the democratic process.

In contrast, the advent of electronic voting systems (e-voting) has addressed many inefficiencies inherent in traditional election processes. Research conducted by Smith and Clark (2005) indicated that e-voting systems could significantly reduce costs, minimize errors, improve accessibility, and increase voter engagement. Despite these advantages, adopting e-voting solutions has been slow in many educational institutions, and NORSU-Guihulngan was no exception. As a result, the benefits of modern electoral technology remained largely untapped, leaving the institution's electoral process outdated and inefficient. While other educational institutions that had embraced e-voting platforms reported enhanced participation rates, streamlined election procedures, and improved voter experiences, NORSU-Guihulngan continued to rely on traditional methods that failed to capitalize on the potential of modern technology. This gap in technological adoption highlighted the need for a more forward-thinking approach to student elections at NORSU-Guihulngan.

Several critical shortcomings, including delays in vote tallying, administrative inefficiencies, and limited student accessibility characterized the traditional manual voting system employed at NORSU-Guihulngan. These issues contributed to lower voter turnout, fewer candidates running for student government positions, and administrative difficulties, which undermined the democratic nature of student governance. Furthermore, the current system struggled to keep up with the evolving technological expectations of the student body, which had become increasingly accustomed to digital interfaces and online interactions. The limitations of the manual voting system at NORSU-Guihulngan necessitated a comprehensive solution that addressed the institution's technical and contextual barriers. While e-voting systems implemented at other universities had demonstrated significant benefits, such as automation, real-time result generation, and enhanced transparency, they also faced challenges, including ensuring data security and requiring stable internet connectivity. This study aimed to design an e-voting application that was secure, user-friendly, and contextually appropriate for NORSU-Guihulngan, addressing both the technical and administrative barriers that had hindered progress thus far.

The main objective of this study was to develop and evaluate a secure, user-friendly, and transparent e-voting application that would replace the existing manual voting system at NORSU-Guihulngan. Specifically, the study aimed to design a customized e-voting platform that addressed the unique needs and challenges of NORSU-Guihulngan students and administrators. The application was to incorporate features such as secure voter authentication, real-time result generation, and enhanced data transparency. It also sought to evaluate the effectiveness of the proposed e-voting application in terms of accessibility, user experience, and administrative efficiency, with feedback from students and administrators regarding the ease of use, security features, and the overall impact on voter engagement. The study aimed to compare the e-voting system with the existing manual voting system regarding efficiency, accuracy, and voter turnout, explicitly identifying the gaps the e-voting platform addressed. Finally, the study provided recommendations for further improvement and possible expansion of the e-voting system to other campuses or educational institutions, offering a model for others seeking to modernize their electoral processes.

This study held significant value in the context of NORSU-Guihulngan and student governance in educational institutions. First, it aimed to improve the efficiency and accuracy of the election process, providing a reliable platform for students to express their political preferences. By eliminating the administrative inefficiencies and errors associated with manual voting, the e-voting system could ensure that election results are accurate, timely, and transparent. Furthermore, by offering a secure, digital platform, this study aimed to foster greater inclusivity, enabling more students to participate in the electoral process, regardless of logistical barriers such as time constraints or physical limitations. The proposed e-voting system would also improve the transparency of the electoral process, providing students with confidence in the fairness and integrity of the election results. Finally, the proposed e-voting platform at NORSU-Guihulngan would serve as a model for other institutions seeking to modernize their electoral processes. As digital solutions became increasingly integral to governance, this study had the potential to pave the way for widespread adoption of e-voting systems across the Philippines, enhancing democratic engagement in educational settings.

The proposed solution for NORSU-Guihulngan was the development of an Android-based e-voting application that incorporated a range of features designed to overcome the shortcomings of the existing manual voting system. Key features of the proposed e-voting platform included secure voter authentication, real-time vote tallying, a user-friendly interface, data transparency, and offline functionality. The application was to ensure that only authorized students could cast their votes by incorporating secure login mechanisms, such as two-factor authentication or biometric verification. It was also designed to allow for automatic vote tallying, providing instant feedback and ensuring that results were available immediately after the election period ended. The app was to be designed with a simple, intuitive interface that made it easy for students to navigate and vote quickly, reducing barriers to participation. Additionally, the application would offer real-time updates on voter participation and election results, fostering greater trust in the system. To address potential issues with internet connectivity, the application was designed to allow for offline voting, with votes being synchronized once an internet connection was restored.

Adopting an e-voting system at NORSU-Guihulngan offered a transformative solution to the challenges the current manual voting process faces. By leveraging the benefits of digital technology, the proposed e-voting application promised to enhance the efficiency, accuracy, and inclusivity of student elections, fostering greater democratic engagement within the campus community. Through this study, NORSU-Guihulngan served as a model for other educational institutions seeking to modernize their electoral processes, bridging the gap between traditional practices and innovation potential.

2.0 Methodology

2.1 Research Design

This research used a descriptive-developmental method. This method works primarily on describing, comparing, analyzing, and interpreting existing data (Gillaco, 2014). The developmental method is a body of research literature that pertains directly to instructional development, which means an output will be developed after conducting this research. This approach combines descriptive methods, which aim to analyze and describe the current state or process (e.g., manual voting inefficiencies), with developmental research, which focuses on designing, developing, and testing a new system (e.g., the e-voting application for the NORSU-Guihulngan Student Government).

2.2 Research Locale

The study was conducted at Negros Oriental State University (NORSU) - Guihulngan Campus, Guihulngan City, Negros Oriental, Philippines. NORSU-Guihulngan Campus is committed to providing excellent instruction, conducting relevant and responsive research and extension services, and maintaining quality assurance through the dedication of its highly competent and motivated workforce. The study focused on the campus as the research environment to analyze the implementation of an e-voting application for the NORSU-Guihulngan Student Government election, addressing challenges in the traditional manual voting system. The strategic location and institutional mandate made it an ideal setting for conducting this study, emphasizing the relevance of technology-driven innovations in improving electoral processes.

2.3 Research Participants

The respondents of the study consisted of 106 participants from Negros Oriental State University – Guihulngan Campus, who contributed by answering a Google Forms questionnaire. A stratified random sampling technique was employed to ensure a representative distribution of respondents across different student groups, such as year level, academic programs, and involvement in student government activities. This approach allowed for a more comprehensive understanding of the perspectives and experiences of various subgroups within the campus. The respondents were carefully selected based on their familiarity with the current manual voting system for student government elections, as they were deemed knowledgeable about the issues and challenges encountered with the existing process. Their insights were crucial in the evaluation process, as they directly assessed the inefficiencies of the manual system and provided valuable suggestions for potential improvements. The responses gathered from this diverse group of respondents formed the foundation for the analysis and subsequent recommendations to enhance the electoral process and inform the development and implementation of the proposed e-voting application.

2.4 Research Instrument

The data-gathering instrument was a modified tool designed specifically for this study, using Google Forms to distribute survey and interview questionnaires to respondents. The instrument aimed to collect insights regarding the potential implementation of the e-voting application at NORSU-Guihulngan Campus, focusing on its functionality, user interface, security, accessibility, transparency, and reliability. For validity, the researchers used a validation tool with a rating scale of 1 to 5, where 5 represented "very much valid" and 1 was "not valid." Expert validation yielded a score of 4.67, confirming the instrument's high validity. A survey was conducted for reliability testing with 30 respondents aged 15-30. The Cronbach's Alpha test was applied to the Likert scale survey, yielding a 1.21 score indicating excellent reliability. Pilot tests were also conducted to refine the instrument based on participant feedback, ensuring it effectively captured relevant data to assess the e-voting system's potential to improve the electoral process.

2.5 Data Gathering Procedure

The data-gathering process involved surveying CS/IT experts, faculty members, and students currently studying and teaching at the Negros Oriental State University-Guihulngan Campus. The survey aimed to demonstrate how students and administrators would interact with and utilize the proposed e-voting system, ensuring a comprehensive understanding of its functionality and usability. To minimize distractions and optimize data collection, the researcher employed a time-allotted scheme for administering the questionnaire. This approach ensured respondents had sufficient time to provide thoughtful and accurate responses. Once the questionnaires were completed, they were immediately retrieved to maintain the integrity of the data. After collection, the responses were tallied, calculated, and analyzed using appropriate statistical tools. This systematic approach allowed the researcher to derive meaningful insights, ensuring that the data effectively informed the evaluation of the e-voting system's impact and feasibility.

2.6 Data Analysis

The collected data from the responses to the Google Forms questionnaire, completed by students of Negros Oriental State University-Guihulngan Campus, were meticulously analyzed using a statistical software package. Cronbach's Alpha was employed to ensure the reliability of the research instruments, and the results confirmed the instrument's validity and dependability. For descriptive analysis, frequency counts and percentages were utilized to evaluate the existing manual voting process for student government elections and identify the challenges students faced. These insights were a foundation for designing and developing the proposed e-voting application. The weighted mean was applied to assess the newly developed e-voting system's effectiveness. This involved calculating the weight of each category, summing all weights, multiplying each value by its respective weight, and dividing the total by the sum of weights. This method comprehensively measures the system's performance across various parameters. Standard deviation was used to analyze the homogeneity and heterogeneity of the ratings provided by IT experts, offering insights into the consistency of their assessments. Additionally, a Likert rating scale was employed to categorize and interpret the statistical results of the system's effectiveness. The findings were systematically presented in tables for clarity and ease of understanding, providing a detailed evaluation of the e-voting application's functionality, usability, and overall impact.

2.7 Ethical Considerations

Formal letters were provided to the respondents, clearly outlining the purpose and scope of the study. Respondents' participation was voluntary and free to consent or decline without any obligation. To ensure privacy, their responses were treated with the highest level of confidentiality, and their identities remained anonymous throughout the data collection, processing, and interpretation stages. After the data was analyzed and reported, the completed questionnaires were securely disposed of through shredding and incineration. Furthermore, the respondents were thoroughly informed about the study's objectives, ensuring their complete understanding and voluntary participation.

3.0 Results and Discussion

3.1 Students' Characteristics

Figure 1 shows the participation of Negros Oriental State University - Guihulngan students in the student government election. According to the results, 91.5% of the respondents said YES, while 8.5% said NO. This implies that most respondents participated in the student government election. According to Oki and Idrus (2020), schools have become a strategic position in developing democratization, especially in politics, because their political interests have emerged and are developing now.

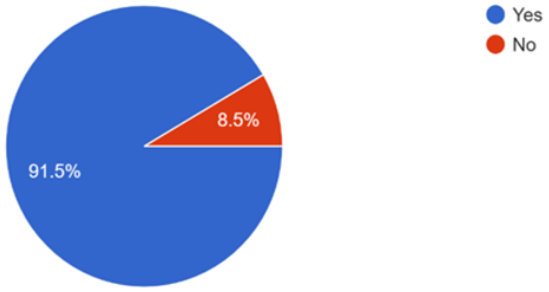

Figure 1. *Participation of Students in the Student Government Election*

Figure 2 shows that the current student government election at Negros Oriental State University - Guihulngan utilizes paper ballots. According to the results, 79.2% of the respondents preferred paper ballots, 16% preferred an online voting platform, and 4.7% preferred an e-voting application. This implies that most respondents favored paper ballots for the current NORSU-Guihulngan student government election. According to Herrnson (2008), electronic voting systems were developed, in part, to make voting easier and to boost voters' confidence in the election process.

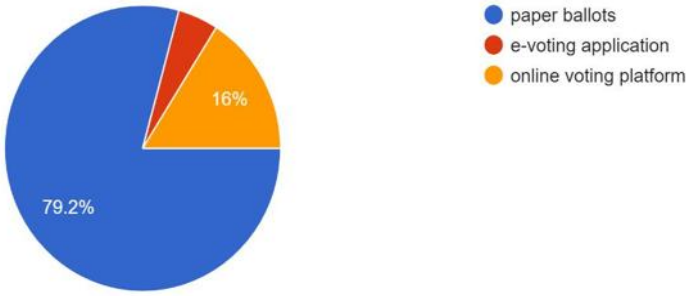

Figure 2. *Current Student Government Election Utilizes Paper Ballots*

Figure 3 illustrates the challenges faced by students at Negros Oriental State University - Guihulngan during the student government election. The most prominent issue was ballot confusion, which ranked first, affecting 42.5% of respondents. Security concerns came in second, reported by 22.6% of students. Lack of transparency was ranked third, cited by 17.9%, while insufficient voting stations rounded out the list at fourth place with 17%. These findings underscore the need for improvements in ballot design, security measures, transparency, and voting

infrastructure to ensure a smoother and more effective election process. But according to Fauzi and Habibi (2023), the implementation of e-voting requires supportive infrastructure, adequate public education, and a robust legal framework.

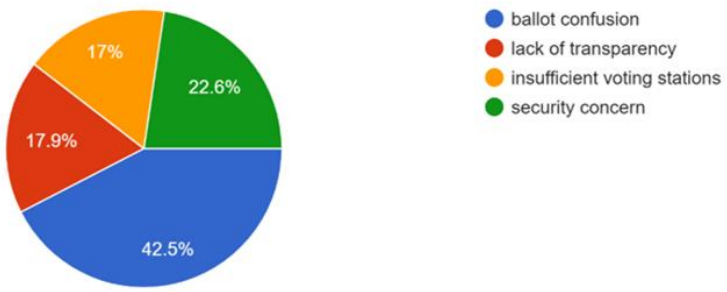

Figure 3. *Problems Encountered by Students During the Student Government Election*

Figure 4 highlights the rankings of the top four features of the Negros Oriental State University - Guihulngan student government e-voting application, as rated by users. E-voting can provide an efficient and cost-effective method for conducting voting procedures while encouraging the participation of specific groups, such as young or disabled voters (Gritzalis, 2002). The user-friendly interface leads the list, which secured the top spot with a preference rate of 74.5%. The application's ballot verification and auditing capabilities ranked second, garnering 72.6%. Real-time vote tallying follows at third place with 62.3%, while secure authentication methods rank fourth, receiving 58.5%. These results emphasize the importance of usability, transparency, efficiency, and security in enhancing the e-voting experience. E-voting can be an efficient and cost-effective way to conduct a voting procedure and to attract specific groups of people (e.g., young or disabled electors) to participate

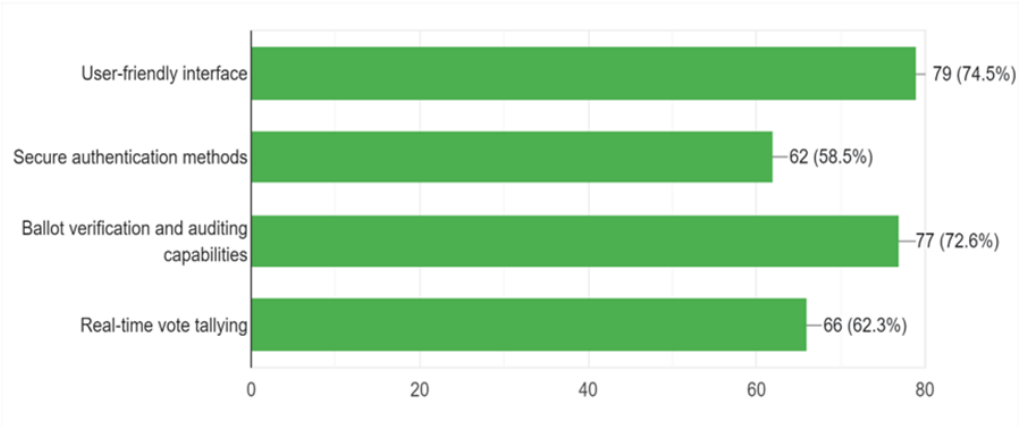

Figure 4. *Ranking of the Top 4 Features or Functionalities of Student Government E-Voting Application*

Figure 5 presents the results of the quality assessment of the e-voting system at Negros Oriental State University - Guihulngan, based on a Likert scale evaluation. The features assessed include the user interface, security, accessibility, transparency, and reliability. Designing an airtight and reliable e-voting system is, therefore, an excellent task, in that the system that must be developed must protect the privacy of the voter, be easily understood and used by the entire voting populace-no matter who they are or where they come from (Rogers & Kyomuhendo, 2023). The results reveal that the user interface scored highest, with most respondents rating it as "5" (excellent). Similarly, security and accessibility received strong positive feedback, with many respondents providing high ratings of "5" and "4." Transparency also performed well. However, it had slightly more mixed responses, including lower scores, indicating room for improvement. While generally well-rated, reliability displayed a small distribution of lower scores, suggesting occasional concerns about its consistency. These findings reflect the system's overall strength in usability and security but highlight further opportunities to enhance its transparency and reliability.

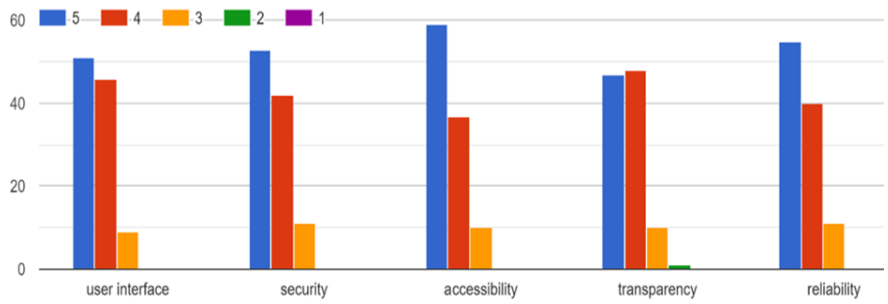

Figure 5. *Results of the E-voting Quality Assessment*

3.2 E-Voting Application Assessment

Table 1 presents that the user interface received an average weight of 4.39, indicating an excellent rating. The respondents highly appreciated its design and functionality. Security also received an average weight of 4.39, suggesting excellent on and data integrity. The system's accessibility, with an average weight of 4.46, was rated excellent, ensuring that users can easily navigate and interact with the application. The transparency aspect, with an average weight of 4.31, was also deemed excellent, indicating a high level of openness and clarity in the process. The system's reliability, with an average weight of 4.41, was rated as excellent, implying a consistent and dependable performance. Overall, the total average rating of 4.39 signifies that the respondents regarded the system as excellent in its various aspects, making it a highly reliable and user-friendly solution.

Table 1. *Student Government E-Voting Application Assessment*

Area	Mean	Interpretation
1. User interface	4.39	Excellent
2. Security	4.39	Excellent
3. Accessibility	4.46	Excellent
4. Transparency	4.31	Excellent
5. Reliability	4.41	Excellent
Overall Mean	**4.39**	**Excellent**

The evaluation results in Table 2 demonstrate the high functionality of the NORSU Guihulngan Student Government (SG) e-voting application, as assessed by IT experts. The application's performance was measured across four key parameters: suitability, accuracy, security, and compliance. Among these, suitability achieved the highest weighted mean of 3.70, indicating that the system is highly appropriate and efficient in supporting the voting process. Security followed closely with a weighted mean of 3.63, highlighting the application's robust measures to safeguard data and ensure voter confidentiality. Accuracy received a weighted mean of 3.52, reflecting its ability to record and process votes with minimal errors reliably. Similarly, compliance was rated 3.50, signifying that the application adheres to relevant standards and regulations governing e-voting systems.

Table 2. *Functionality of the SG E-voting Application*

Area	Mean	Interpretation
Suitability	3.70	Very Functional
Accuracy	3.52	Very Functional
Security	3.63	Very Functional
Compliance	3.50	Very Functional
Overall Mean	**3.58**	**Very Functional**

The application's overall functionality garnered a grand mean of 3.58, which falls under the verbal description "Very Functional." This result underscores the system's capability to effectively meet the technical and operational requirements of an e-voting platform. These ratings suggest that the SG e-voting application is a reliable and efficient tool for facilitating student elections. The high scores across all categories affirm the system's ability to provide essential features, such as user-friendliness, secure voting, and compliance with election protocols. The strong performance in suitability indicates that the application is well-designed to fulfill the needs of the voting process, while its security measures ensure trustworthiness and data integrity. Accuracy and compliance scores,

though slightly lower, still indicate strong performance, suggesting opportunities for further refinement to enhance these aspects. Overall, the results validate the application as a modern and effective alternative to traditional voting methods, capable of improving election efficiency and student participation.

The evaluation results in Table 3 highlight the reliability of the NORSU Guihulngan Student Government (SG) e-voting application, with a grand mean rating of 3.49, classified as "Very Reliable." The assessment measured reliability across four parameters: maturity, fault-tolerance, recoverability, and compliance, all contributing to the system's overall dependability. Recoverability achieved the highest weighted mean of 3.60 among these parameters, indicating that the application can effectively restore functionality and data integrity during system disruptions. Compliance followed with a score of 3.56, reflecting the system's firm adherence to established reliability standards and best practices. Fault tolerance, rated at 3.50, highlights the application's capability to continue functioning effectively despite minor errors or issues. Lastly, maturity, with a weighted mean of 3.31, underscores the system's stability and readiness for real-world use, suggesting slightly more room for improvement than the other parameters.

Table 3. *Reliability of the SG E-voting Application*

Area	Mean	Interpretation
Maturity	3.31	Very Reliable
Fault – tolerance	3.50	Very Reliable
Recoverability	3.60	Very Reliable
Compliance	3.56	Very Reliable
Overall Mean	**3.49**	**Very Reliable**

The results demonstrate that the SG e-voting application is a dependable platform for conducting student elections, consistently delivering stable and accurate performance. The high rating in recoverability ensures that any technical setbacks during the voting process can be swiftly addressed without compromising data or results. Similarly, fault-tolerance and compliance ratings affirm that the system is robust and aligned with reliability standards, fostering user trust. Although maturity received a slightly lower score, it still falls within the "Very Reliable" category, suggesting that the application is stable but may benefit from further optimization or updates to enhance its long-term performance. These findings validate the e-voting application's capability to provide a reliable, secure, and efficient voting experience, making it a strong alternative to traditional voting methods. Its dependability instills confidence in administrators and voters, ensuring smooth and credible election processes.

The evaluation results presented in Table 4 assess the usability of the NORSU Guihulngan Student Government (SG) e-voting application, with an overall grand mean rating of 3.61, classified as "Very Usable." This suggests that the application provides an intuitive and user-friendly experience, making it easy for students to interact with the system during the election process. The parameters assessed include understandability, learnability, operability, and compliance, all contributing to the system's overall usability. Understandability received the highest weighted mean of 3.83, indicating that users find the application's features and processes easy to comprehend. This suggests that the interface and instructions are straightforward, reducing the likelihood of confusion or mistakes. Operability, with a rating of 3.60, reflects how smoothly users can interact with the application, suggesting that it is functional and straightforward. Learnability, which scored 3.50, indicates that users can quickly grasp how to use the system, although some initial learning or guidance may be required. Lastly, compliance, rated at 3.51, reflects how well the application meets usability standards, ensuring it adheres to best practices for creating accessible and user-friendly systems.

Table 4. *Usability of the SG E-voting Application*

Area	Mean	Interpretation
Understandability	3.83	Very Usable
Learnability	3.50	Very Usable
Operability	3.60	Very Usable
Compliance	3.51	Very Usable
Overall Mean	**3.61**	**Very Usable**

These results suggest that the SG e-voting application is highly accessible and easy to use, with its user interface and experience being well-designed for smooth interaction. The high score in understandability implies that students can easily navigate the system without confusion. In contrast, the scores for operability and learnability

show that users can efficiently operate the system and quickly become familiar with its functions. Although compliance received a slightly lower score, it still indicates that the application follows important usability guidelines. The usability evaluation demonstrates that the SG e-voting application provides a seamless, user-friendly experience, making it highly suitable for student participation in elections. These factors contribute to a positive and efficient voting experience that encourages voter turnout and engagement.

Table 5 presents the evaluation results of the efficiency of the NORSU Guihulngan Student Government (SG) e-voting application, with an overall grand mean rating of 3.50, categorized as "Very Efficient." This indicates that the application performs tasks quickly and optimally, enhancing the overall election process. The evaluation measured three key parameters: time behavior, resource utilization, and compliance. Resource utilization and compliance received weighted means of 3.60, suggesting that the application efficiently uses available resources while adhering to established efficiency standards and best practices. These high scores indicate that the system optimally manages hardware, software, and other resources, ensuring smooth operation during the voting process. Time behavior, with a weighted mean of 3.30, shows that the application performs tasks promptly, though there may be slight delays in some aspects of the process.

Table 5. *Efficiency of the SG E-voting Application*

Area	Mean	Interpretation
Time-behavior	3.30	Very Efficient
Resource Utilization	3.60	Very Efficient
Compliance	3.60	Very Efficient
Overall Mean	**3.50**	**Very Efficient**

These results highlight the SG e-voting application's ability to deliver an efficient and timely voting experience. The high ratings for resource utilization and compliance underscore the system's practical management of technological resources and alignment with performance standards, which are crucial for smooth operations during elections. Although time behavior received a slightly lower score, it reflects a generally efficient system that processes tasks quickly. The evaluation indicates that the application supports a streamlined and effective voting process, which is crucial for reducing delays and ensuring timely election results. This efficiency not only enhances user experience but also contributes to the overall success and credibility of the e-voting system.

Table 6 presents the evaluation results for the maintainability of the NORSU Guihulngan Student Government (SG) e-voting application, which received a grand mean rating of 3.54 and is categorized as "Very Maintainable." This suggests that the application is designed with features that support easy maintenance, including updates, bug fixes, and other ongoing adjustments necessary to ensure its longevity and continued functionality.

Table 6. *Maintainability of the SG E-voting Application*

Area	Mean	Interpretation
Analyzability	3.60	Very Maintainable
Changeability	3.70	Very Maintainable
Stability	3.40	Very Maintainable
Testability	3.60	Very Maintainable
Compliance	3.40	Very Maintainable
Overall Mean	**3.54**	**Very Maintainable**

The evaluation measured five key parameters: analyzability, changeability, stability, testability, and compliance. With a weighted mean of 3.70, changeability received the highest score, indicating that the application can be easily modified or updated as needed. This is essential for adapting to new requirements or addressing emerging issues. Analyzability and testability, scoring 3.60, suggest that the system can be thoroughly analyzed for potential problems and tested for functionality, which is important for identifying and fixing bugs or improving performance. Stability, with a rating of 3.40, reflects the system's ability to operate consistently without significant issues, though it shows that there may be minor challenges in maintaining long-term stability. Finally, compliance, also rated at 3.40, indicates that the application adheres to standards and practices that support easy maintenance and support.

These results emphasize that the SG e-voting application is designed for easy maintenance, ensuring that it can be updated, modified, and tested with minimal difficulty. The high scores for changeability and analyzability suggest

that the application can be adapted and improved as new needs or challenges arise, ensuring its long-term viability. Although stability and compliance received slightly lower scores, they still fall within the "Very Maintainable" range, indicating that while the system may encounter occasional issues, it is overall stable and compliant with necessary maintenance practices. Overall, the maintainability of the e-voting application is strong, ensuring that it can be sustained and improved over time without significant difficulty. This is critical for ensuring the system's continuous functionality and ability to adapt to future developments or requirements in the electoral process.

Table 7 presents the evaluation results for the portability of the NORSU Guihulngan Student Government (SG) e-voting application, which received a grand mean rating of 3.50, categorized as "Very Portable." This rating indicates that the application is highly adaptable and can be easily deployed and used across various platforms, operating systems, or devices, ensuring flexibility and broad accessibility for users. The evaluation assessed four key parameters: adaptability, installability, replaceability, and compliance. Adaptability and replaceability, each scoring 3.50, suggest that the application can be easily adjusted or replaced in different environments or platforms without significant difficulties. Installability, with a score of 3.40, reflects that the application can be installed with minimal issues, though there may be slight challenges under specific conditions. Compliance, with the highest rating of 3.60, indicates that the application adheres to standards that support seamless portability across platforms and devices.

Table 7. *Portability of the SG E-voting Application*

Area	Mean	Interpretation
Adaptability	3.50	Very Portable
Install ability	3.40	Very Portable
Replaceability	3.50	Very Portable
Compliance	3.60	Very Portable
Overall Mean	**3.50**	**Very Portable**

The results highlight the application's portability, emphasizing its ease of deployment and use across various devices, operating systems, and platforms. The high ratings for adaptability and replaceability suggest that the application can be modified or transferred to different technological environments with minimal adjustments. Install ability shows that the application is easy to set up, although some platforms may present minor installation challenges. The strong rating for compliance indicates that the application meets the necessary standards for portability, ensuring its usability in diverse environments. Overall, the e-voting application's portability is well-rated, ensuring that it can be utilized across different devices and systems, which is essential for widespread use in various settings. This flexibility supports the practical and accessible implementation of e-voting processes, making it a versatile tool for the NORSU Guihulngan Student Government elections and potentially other similar applications.

3.3 Perceived Usefulness and Ease of Use of the E-voting Application

Table 8 summarizes the perceived usefulness of the NORSU Guihulngan e-voting application, with a grand mean rating of 3.50, which is categorized as very useful. This high rating indicates that users view the application as a valuable tool that offers significant benefits, enhancing the efficiency and effectiveness of the voting process. The perceived usefulness was assessed across six key features: enhanced accessibility, time and cost efficiency, real-time results, enhanced accuracy, increased security measures, and audit trail and transparency. The enhanced accessibility of the application, which allows voters to participate remotely from any location with internet access, received a rating of 3.50, highlighting its substantial contribution to broadening voter participation. Time and cost efficiency, rated 3.60, reflects the application's effectiveness in reducing the time and financial resources associated with traditional paper-based voting methods. The ability to generate and announce real-time results also received a 3.50, showcasing the application's capacity to expedite the election process. Enhanced accuracy in vote counting and recording, which minimizes human error, was rated at 3.50, reinforcing the software's contribution to ensuring reliable outcomes. The increased security measures (3.50) ensure that the integrity and confidentiality of the voting process are protected, fostering trust among users. Finally, audit trail and transparency received a rating of 3.40, reflecting the application's ability to maintain a detailed record of all voting activities, which promotes transparency and accountability in the election process.

Table 8. *Perceived Usefulness of the E-Voting Application*

Indicators	Mean	Interpretation
1. Enhanced Accessibility: The NORSU Guihulngan e-voting application offers an enhanced level of accessibility, allowing voters to participate in the voting process remotely from any location with an internet connection.	3.50	Very Useful
2. Time and Cost Efficiency: The e-voting application streamlines the voting process, reducing the time and cost of traditional paper-based voting methods.	3.60	Very Useful
3. Real-Time Results: The NORSU Guihulngan e-voting application generates and announces results in real time.	3.50	Very Useful
4. Enhanced Accuracy: The e-voting application minimizes the possibility of human error in vote counting and recording.	3.50	Very Useful
5. Increased Security Measures: The NORSU Guihulngan e-voting application can implement robust security measures to safeguard the integrity and confidentiality of the voting process.	3.50	Very Useful
6. Audit Trail and Transparency: The e-voting application can provide an audit trail, recording and preserving a detailed history of all voting activities.	3.40	Very Useful
Overall Mean	**3.50**	**Very Useful**

The perceived usefulness of the NORSU Guihulngan e-voting application indicates that the software provides significant advantages over traditional voting methods. Users highly value the application's accessibility, which allows remote participation, and its ability to save time and costs, ensuring a more efficient process. Real-time result generation and enhanced accuracy contribute to the reliability and speed of the election. Moreover, the application's security features are crucial in maintaining trust, while the audit trail function ensures transparency and accountability. With a grand mean rating of 3.50, these features demonstrate the e-voting system's effectiveness in improving the voting process, confirming its overall usefulness in the NORSU Guihulngan elections.

Table 9 outlines the perceived ease of use of the NORSU Guihulngan e-voting application, which received a grand mean rating of 3.56, indicating that the application is straightforward. This high rating suggests that users find the system intuitive, user-friendly, and efficient, with minimal barriers to interaction. Several features contribute to this positive perception of ease of use. These include an intuitive user interface, clear instructions, a familiar voting process, responsive design, error prevention mechanisms, and accessible help and support resources.

Table 9. *Perceived Ease of Use of the E-Voting Application*

Indicators	Mean	Interpretation
1. Intuitive User Interface: The NORSU Guihulngan e-voting application has a user-friendly interface, making it easy for voters to navigate and interact with the system.	3.60	Very Easy to Use
2. Clear Instructions and Prompts: The application provides clear and concise instructions and prompts throughout the voting process.	3.50	Very Easy to Use
3. Familiar Voting Process: The e-voting application emulates the familiar paper-based voting process, maintaining the traditional elements that voters are accustomed to.	3.60	Very Easy to Use
4. The application is developed with responsive design principles, ensuring compatibility across different devices and screen sizes.	3.60	Very Easy to Use
5. Error Prevention and Validation: The e-voting application incorporates error prevention mechanisms and validation checks to minimize mistakes or invalid entries.	3.60	Very Easy to Use
6. Help and Support Resources: The NORSU Guihulngan e-voting application provides easily accessible help and support resources to assist users throughout the process.	3.50	Very Easy to Use
Overall Mean	**3.56**	**Very Easy to Use**

The intuitive user interface received a rating of 3.60, reflecting that voters can easily navigate and interact with the system. The clear instructions and prompts, rated at 3.50, ensure that voters understand each step, reducing confusion during voting. The application's familiar voting process, rated at 3.60, makes it easy for users to transition from traditional paper-based voting by retaining familiar elements. Additionally, the application was designed with responsive design principles (rated 3.60), ensuring compatibility across various devices and screen sizes, which enhances accessibility for a broader range of users. Error prevention and validation checks, also rated at 3.60, help minimize mistakes and ensure valid entries, improving the accuracy of the voting process. Finally, the availability of help and support resources, rated at 3.50, provides users with assistance throughout the process, enhancing the application's ease of use.

The perceived ease of use of the NORSU Guihulngan e-voting application demonstrates its user-friendliness and accessibility. With a grand mean rating of 3.56, the application is viewed as straightforward and intuitive, making it easy for voters to engage with the system. Features such as a straightforward interface, familiar voting methods, and responsive design ensure that users of all technological backgrounds can easily participate. Incorporating error prevention mechanisms and accessible support resources further enhances the application's usability, ensuring that voters can complete the process with minimal difficulties. The combination of high perceived usefulness and ease of use reinforces the positive impact of the NORSU Guihulngan e-voting application on the voting experience, offering a reliable, efficient, and accessible platform for democratic participation.

3.4 Development of the Application

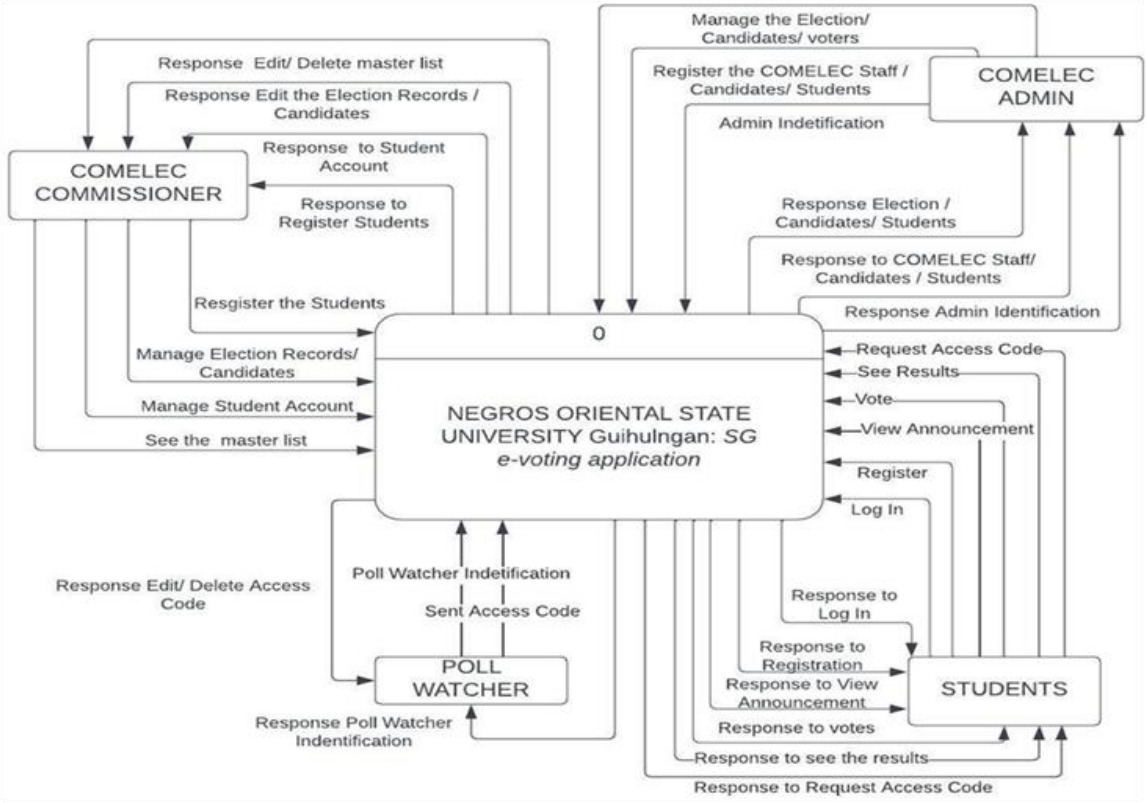

Figure 6. *Context Flow Diagram of the E-Voting Application*

Figure 6 depicts the Context Flow Diagram (CFD) of the NORSU Guihulngan SG e-voting application, an essential tool in systems analysis and design. The diagram visually represents the high-level interactions between the various entities involved in the system and their respective roles in the voting process. The external entities in this diagram are the COMELEC Commissioner, COMELEC Admin, Poll Watcher, and Students, each playing a vital role in the e-voting system:

> *COMELEC Commissioner is responsible for registering students, managing election records, and overseeing the election process. They also handle the student accounts and can edit or delete access codes. Their actions directly influence the accuracy and integrity of the voter database.*

> *COMELEC Admin oversees the overall election process, manages election candidates and voters, and registers the COMELEC staff, candidates, and students. They are responsible for ensuring the smooth operation of the e-voting system, from voter registration to election result management.*

Poll Watcher verifies and ensures the integrity of the voting process. They are responsible for identifying voters and monitoring the overall election process. They also manage access codes to ensure that only authorized individuals can access certain aspects of the system.

Students are the primary users of the e-voting application. They log into the system, register for voting, cast their votes, and request results. They can also view announcements related to the election process and receive updates regarding the voting system.

The flow of interactions in the diagram shows how these entities communicate and respond to each other. For example, students request access codes, log into the system, and vote, while the COMELEC Commissioner and Admin manage the election records and identify candidates. The Poll Watcher ensures voter identification and manages access codes for authorized individuals. This context flow diagram maps out the fundamental structure of the NORSU Guihulngan SG e-voting application and the key processes that ensure the system functions effectively. It highlights the smooth interaction between the system components. It helps to visualize the user experience, emphasizing the roles of different users and how they contribute to the voting process.

Figure 7 illustrates the use case diagram for the NORSU—Guihulngan Student Government COMELEC e-voting mobile application. It provides a visual representation of the interactions between various system users and the application, helping to understand the roles, functionalities, and relationships between different components of the e-voting system.

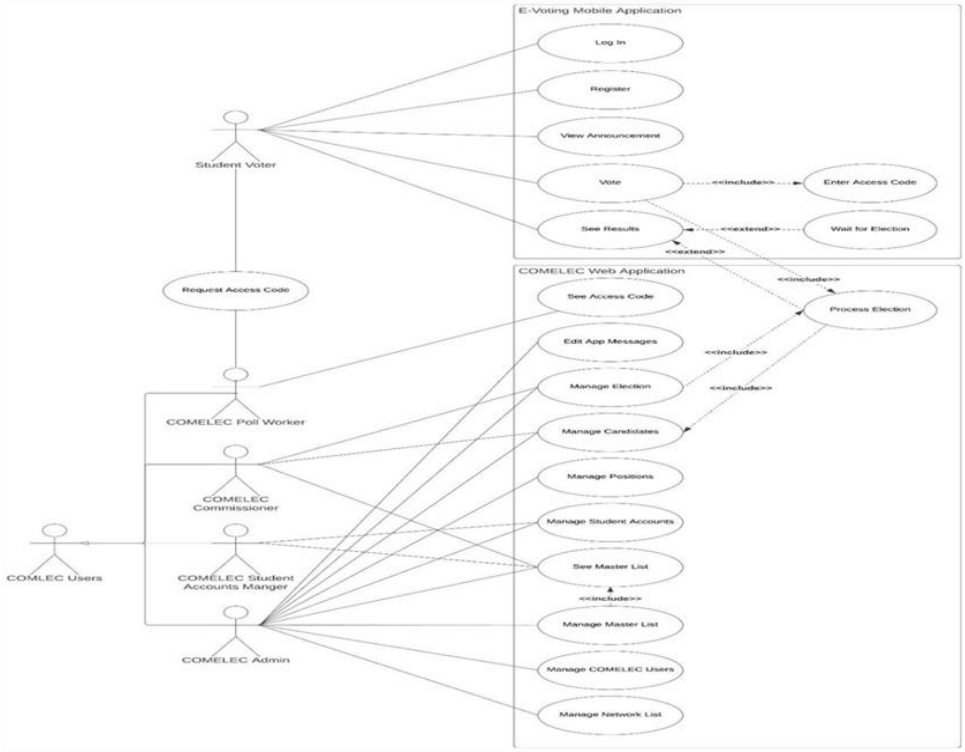

Figure 7. *Use Case Diagrams of Student Government COMELEC E-Voting Mobile Application*

The Student Voter plays a central role in the diagram. The primary actions available to the student include requesting an access code, logging in, registering for the election, viewing announcements, casting a vote, and seeing results. Notably, there is an extended relationship to the Wait for Election use case, indicating that the student may have to wait for election results or the start of the election before engaging in specific actions. The COMELEC Web Application has several key functionalities that facilitate election management. These include processing elections, managing election records, candidates, and positions, and overseeing student accounts. COMELEC users, such as the Poll Worker, Commissioner, Student Accounts Manager, and Admin, interact with

the system based on their designated responsibilities. These roles are associated with managing user accounts, the master list, election details, and network lists.

The diagram also highlights the relationship between different user types and the functionalities they can access. The COMELEC Commissioner has broad access, including managing elections, candidates, and student accounts, while the Poll Worker focuses on verifying access codes and monitoring the election process. COMELEC Admin manages overall system functionality, including user roles and network lists, while COMELEC Student Accounts Manager handles student registrations and accounts. The use case diagram showcases how the application accommodates multiple roles within the election process, emphasizing the comprehensive management and user-specific functionalities integral to the NORSU Guihulngan Student Government's e-voting application.

4.0 Conclusion

The study concludes that the respondents, with their diverse profiles, provided valuable insights into the quality of the NORSU-Guihulngan student government election process. The findings emphasized the inefficiencies of the current manual voting system, particularly the excessive time spent on casting and tallying ballots, which can take 4 to 5 hours. This highlighted the urgent need for technological solutions to streamline the election process and improve efficiency. Implementing an e-voting application emerges as a viable solution to address these issues, offering a more efficient, secure, and transparent alternative. A robust e-voting system featuring a user-friendly interface, secure authentication, ballot verification, auditing capabilities, real-time vote tallying, and strong data privacy measures can significantly enhance the election process.

These features not only improve accessibility but also ensure greater security and transparency, fostering a more reliable and trusted system. The study's findings imply that a thorough evaluation of the e-voting application, based on these criteria, is essential for determining its effectiveness in ensuring fair, efficient, and secure student government elections at NORSU-Guihulngan. Several recommendations arise from these findings. First, students should be encouraged to adopt the e-voting application, as it was rated excellent by the 106 respondents, offering them a firsthand experience of its security and efficiency features. Efforts to improve the current manual voting system should continue, focusing on reducing time consumption and enhancing the election process.

Introducing an e-voting system can help minimize ballot confusion, increase accuracy, and promote transparency, improving the integrity and accessibility of elections. The study also suggests that developers and administrators collaborate to address identified issues, ensuring regular updates and maintaining the system's security and functionality. Post-election surveys should be conducted to collect user feedback, facilitating ongoing improvements. Additionally, usability testing with student representatives will help refine the user experience, and clear communication regarding the voting process, including vote counting and verification methods, is crucial. By implementing these measures, NORSU-Guihulngan can optimize its election process, providing a reliable, efficient, and inclusive platform that enhances voter confidence and participation. This will improve the immediate election process and set a precedent for other institutions seeking to modernize their electoral systems, reinforcing the importance of technological solutions in advancing democratic practices.

5.0 Contributions of Authors

Eden Grace V. Tabanao contributed to the formal analysis, writing, review, editing, visualization, and funding acquisition.

Jed Christian L. Cece was responsible for data curation, conceptualization, writing of the original draft, funding acquisition, validation, methodology, and project administration.

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7.0 Conflict of Interests

The authors declare that they have no known competing financial interests or personal relationships that might influence the work reported in this paper.

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