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Development and Evaluation of School Performance and Enhanced Consolidation, Tracking, Reporting and Analytics System (SPECTRA) for Data-Driven Management of Schools Division of Surigao City

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Abstract

This study develops and evaluates the School Performance and Enhanced Consolidation, Tracking, Reporting, and Analytics System (SPECTRA) to address the monitoring and reporting challenges faced by the Schools Division of Surigao City. Using a descriptive-developmental approach and the Rapid Application Development (RAD) model, the researchers designed the system to streamline the Schools Monitoring, Evaluation, and Adjustment (SMEA) process. School heads, district supervisors, and Curriculum Implementation Division (CID) staff continuously provided input throughout the design phase, ensuring a user-centric solution that facilitates real-time data consolidation and performance reporting.

The researchers assessed SPECTRA using the ISO/IEC 25010:2011 software quality standards and found high ratings across all quality attributes, including functional suitability, usability, reliability, security, maintainability, and portability. Respondents from diverse demographic backgrounds consistently rated the system to a very great extent, indicating its broad usability and acceptance. Key system features—such as automated notifications, analytics dashboards, and a built-in digital assistant—simplify tasks for users with varying technical backgrounds.

The findings confirm SPECTRA's technical robustness and adaptability. Expert evaluators also validate its architectural soundness, maintainability, and security. Based on user feedback, the developers enhanced the system by expanding analytics access to school heads, demonstrating its responsiveness to evolving needs. Overall, SPECTRA offers a scalable and sustainable digital solution that supports data-driven educational planning and decision-making.

Keywords: Software Quality Evaluation, Data-driven decision-making, Educational Data Analytics

1. INTRODUCTION

Efficient data management is crucial for enhancing educational systems, ensuring accurate school performance monitoring, and supporting informed decision-making. However, the Schools Division of Surigao City faces persistent inefficiencies in consolidating Schools Monitoring, Evaluation, and

Adjustment (SMEA) reports. Instituted in 2018 by the Regional Office's Quality Assurance Division in Caraga, SMEA has continuously evolved to facilitate quarterly progress monitoring and the creation of school data banks. Despite improvements in templates and data gathering, school heads struggle with existing tools like Google Sheets, citing security issues, lack of user-friendliness, and inefficiencies in report consolidation, leading to delays and compromised data confidentiality.

Research highlights the need for secure, user-friendly, and automated reporting systems in education. Bates (2019) emphasizes that intuitive digital tools reduce the cognitive burden on educators, while Johnson and Smith (2020) stress the importance of automation in ensuring data accuracy and confidentiality. Lemoine et al. (2019) advocate for real-time reporting systems that promote transparency and collaboration among stakeholders, and Anderson and Carter (2021) highlight their role in improving administrative effectiveness and learning outcomes. These findings align with the Curriculum Implementation Division's (CID) mandate under RO No. 004 s. 2020 to consolidate SMEA reports for technical assistance and school improvement.

Existing tools fail to address the unique challenges of SMEA reporting in Surigao City's Schools Division. The lack of automation in consolidating multiple school reports causes inefficiencies and delays, while manual processes increase errors and security risks due to unrestricted access. Additionally, the absence of real-time analytics prevents timely data-driven decision-making. These limitations hinder school administrators and division staff from effectively utilizing SMEA for educational improvement. Addressing these gaps is essential to enhance the efficiency and reliability of school reporting systems.

SPECTRA is a transformative solution integrating advanced data analytics to modernize SMEA reporting in alignment with national and global education strategies. It supports Sustainable Development Goal No. 4 (Quality Education) and Sustainable Development Goal No. 9 (Industry, Innovation, and Infrastructure) by promoting data-driven decision-making and fostering innovation in education management. Built on the Philippine Development Plan (PDP) and the i2FAME strategy, SPECTRA emphasize automation, security, and real-time analytics to improve reporting efficiency. Additionally, it aligns with SNSU's Strategic Research and Innovation Policy (SRIP) and incorporates Gender and Development (GAD) principles to address educational disparities. By streamlining data integration, reinforcing access controls, and enabling real-time insights, SPECTRA empower educators, administrators, and policymakers to make informed decisions, ensuring effective technical assistance and sustainable educational development in Surigao City.

1.2 Review of Literature

In DepEd, SMEA (Schools Monitoring, Evaluation, and Adjustment) is a quarterly process that tracks school performance, assesses key indicators like learning outcomes and resource utilization, and implements data-driven improvements. It enables schools and division offices to analyze trends, address challenges, and provide technical assistance for better education management.

Legal Frameworks

The Department of Education (DepEd) has several legal and policy instruments mandating for effective monitoring and evaluation of educational performance that anchors the School Monitoring, Evaluation, and Adjustment (SMEA) framework implementation within it. These forms the basis for making SMEA an integral tool in attainment of educational quality and accountability.

The general governance framework of basic education in the Philippines is provided for by Republic Act No. 9155. The importance of being accountable as well as being transparent is stressed out in this law with

regards to provision of education services. The law requires establishment of mechanisms that will ensure monitoring and evaluation lead to realization of educational outcomes in line with national objectives. In order to fulfill such obligations this institution has come up with an organized approach to assess school performance systematically thereby pinpointing areas where improvements are required through SMEA initiative.

DepEd Order No.32, s. 2010 (National Education Policy Framework for Monitoring and Evaluation). It introduces a framework for monitoring and evaluation throughout the education system levels within the DepEd jurisdiction, putting emphasis on making decisions based on facts for proper service delivery so schools would achieve their goal. With the help of SMEA, it is possible to realize these requirements as the latter has formalized processes for judging how the schools fare in terms of meeting certain standards while also identifying improvement points.

In accordance with DepEd Order No. 44, s. 2018 (Implementation of the Enhanced Basic Education Information System or EBEIS and Learner Information System or LIS), computerized standards to keep track of the educational programs and services were further developed. The Improved Basic Education Information System (EBEIS) and the Student Information System (LIS) are designed for data concerning students while SMEA complements these by focusing on the overall performance of schools thereby giving a wholesome picture of educational development.

Regional Memorandum No. 004, s. 2020 (Institutionalization of SMEA in Caraga Region). This is an internal communication within Caraga Region making SMEA an official tool for measuring performance in this region which includes the school's division of Surigao city. Specific guidelines have been established to address how the schools should be followed-up using SMEA and its use in determining the need for technical support so that school progress can be monitored at each stage instead of waiting for major failures before making interventions. It has also set a requirement for submitting progress reports every quarter so that data is consolidated and analyzed in good time for usefulness in decision-making process.

DepEd Order No. 24, s. 2022 (Policy Guidelines on Monitoring & Evaluation Framework of the Department of Education). This policy outlines the new monitoring and evaluation directives within DepEd – it stresses that evidence-based reporting systems should under available for all students; their progress should be tracked for overall performance standards. Within this structure, the incorporation of SMEA will highlight how vital it is to ensure that school-based evaluations are in line with the overall quality and equal education goals of DepEd.

In order to achieve national and international development goals, such as the Philippine Development Plan (PDP), Ambisyon Natin 2040, and Sustainable Development Goal (SDG) 4: Quality Education innovative technologies are key. These frameworks stress using evidence-based solutions on dates to tackle fundamental problems while at the same time embracing universal education.

SPECTRA aim to achieve these objectives by simplifying the reporting procedures for SMEAs and at the same time enhancing data governance systems and promoting inclusivity with Gender and Development (GAD) oriented characteristics. Through these inventions inefficiencies of operations are dealt with; at the same time supporting more general aspects related to equality within educational context and sustainability.

Importance of Data Management

Efficiently managing information is important in today's world leading to improved school achievement provided it is supported by evidence (Andersen & Barnes, 2018). Providing a value for Schools Division

of Surigao City, depending on human intervention such as Google sheets causes inefficiencies in reporting for SMEA. The unintuitive nature of these tools ends up slowing the process down leading to mistakes which are made by school heads as well as divisional heads causing frustration. This research paper proposes solutions that will not only reduce the above issues but also bring in predictive analysis on topography adjustment of Kuraya district (Anderson & Carter, 2021).

Security and Confidentiality

The management of data in the systems for educating children is a crucial thing, especially when talking about the sensitive details. When it comes to security matters, some systems such as Google Sheet lack strong features that would prevent one from accessing any unauthorized material once he or she makes an entry into the system (Phelps, 2014). According to the research by Lemoine et al., (2019), for you to maintain the quality of educational records and keep pace with the current standards in confidentiality as far as the privacy is concerned, there should be safe platforms.

On the other hand, SPECTRA address them through the use of access controls that are role based hence limiting who sees what data. The method adopted conforms to universally accepted requirements regarding data protection including European Union's General Data Protection Regulation (GDPR) or any similar laws in Philippines so that no one can access sensitive information without consent (Bautista, 2018).

Real-Time Analytics

In educational settings, it is important to note that real-time analytics means fostering accountability and enabling proactive decision-making. According to the study by Lemoine (2019), analytics could identify trends and address performance issues in time; however; Anderson and Carter (2021) speak about its impact to improve learning outcomes as well as resource allocation.

The existing systems in the Schools Division of Surigao City do not have such a capability, which makes them not very useful for providing effective technical assistance or monitoring progress. To fill this gap, SmartReport offers real-time dashboards and analytics that are aimed at helping administrators make informed decisions that improve school activities in accordance with the Basic Education Learning Continuity Plan (BELCP).

User-Centric Designs Principles

Human friendly designs are a must for smooth transition of new technologies in schools. In their studies, Bates (2019) and Anderson and Carter (2021) bring to light the significance of interfaces that are easy to understand therefore enhancing user satisfaction as well as efficiency of output and productivity.

There is a huge uptake of smart reporting tools across different sectors such as education whose objective is to propel data driven choices while streamlining the report making process (or anything else appropriate). One example is the Blossom-KC's automated data gathering breakthrough innovation which also filters it down into digestible bits that would enable organizations to focus only on what really matters (Blossom-KC, 2019). For example, School Monitoring and Evaluation (SMEA) systems like those used in Philippines evaluate performance levels of all educational institutions by looking into students' achievements together with resource management hence providing information on where improvements are needed from time to time – however, still depending on manual methods including google sheets tools (Macalindong et al., 2021).

In addition, the Organization for Economic Co-operation and Development (OECD) argues that educational establishments should embrace learning analytics tools alongside other forms of digital solutions so as to use real-time information as well as other evidence when choosing what to do within an

institution (OECD, 2020). These steps underpin the significant role that intelligent reporting plays in the delivery of educational services while projecting a basis which is in line with SPECTRA system that aims at redefining how school monitoring and reporting works through automation and artificial intelligence for decisions that are both more productive and efficient.

SPECTRA feature a user-friendly design that caters for the needs of school principals and district administrators. By simplifying entry of data, visualization and creation of reports this system will ensure that it benefits more than just the education sector particularly in terms of School Monitoring and Evaluation (SMEA) reporting processes.

Software Evaluation Using ISO 25010

Evaluating software quality is crucial in determining a system's effectiveness, usability, and sustainability. The ISO/IEC 25010:2011 standard provides a comprehensive quality model for assessing software products. This standard is particularly relevant in evaluating systems like SPECTRA, which are developed for education sector applications where reliability, security, and maintainability are essential.

ISO 25010 outlines eight quality characteristics, namely: Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability (ISO/IEC, 2011). Each characteristic is further divided into sub-characteristics that provide detailed evaluation criteria. These dimensions are recognized globally for guiding software development and quality assurance processes (Wang, 2014).

Studies such as those by Raza et al. (2012) and Shahrokni (2009) have applied ISO 25010 in the educational domain, showing its effectiveness in evaluating Learning Management Systems (LMS) and school information systems. These studies highlighted the need for software systems to support accurate data reporting, analytics, and real-time monitoring — similar to the goals of the SPECTRA platform. For instance, Functional Suitability was seen as essential for aligning system features with user needs, especially in tracking academic performance and administrative tasks.

Usability—one of the core ISO 25010 characteristics—has been extensively explored in systems intended for use by school administrators and teachers. According to Nielsen (2012), usability directly affects system adoption and long-term usage. In the case of SPECTRA, ensuring that users can intuitively navigate and generate reports without extensive technical knowledge enhances its practical value.

As educational systems often handle sensitive data, Security is another critical quality attribute. ISO 25010 emphasizes confidentiality, integrity, and non-repudiation, which are directly relevant to SPECTRA's role in managing school and division-level data. Aljanabi et al. (2018) emphasized that integrating strong security protocols ensures compliance with national data privacy laws, such as the Philippine Data Privacy Act of 2012, further strengthening user trust in educational systems.

Long-term effectiveness of educational platforms also depends on Maintainability, which refers to how easily a system can be updated or modified. Studies by Kaur and Mann (2010) highlight how scalable and maintainable systems are more likely to be sustained in resource-constrained environments, such as public schools in developing regions. This is particularly significant for SPECTRA, which must evolve with changing reporting needs and policies of the Department of Education (DepEd).

Performance Efficiency and Reliability are crucial in ensuring timely report generation and system responsiveness, especially during quarterly SMEA presentations. Research by de Oliveira et al. (2017) demonstrated that systems evaluated for these aspects using ISO 25010 tend to outperform those without structured quality assessments, especially in handling concurrent users and large datasets.

The ISO 25010 model provides a reliable and widely accepted framework for evaluating the quality of

educational systems such as SPECTRA. By aligning the evaluation criteria with the platform's objectives—such as improved reporting accuracy, user-friendly interface, data security, and scalability—SPECTRA can ensure its effectiveness as a transformative tool in the Schools Division of Surigao City. Literature underscores that systems developed and assessed using ISO 25010 are more likely to meet user expectations, promote data-driven decision-making, and contribute to sustainable educational development.

Unified Modeling Language (UML) in System Development

The Unified Modeling Language (UML) has become a standard visual modeling language in software engineering, providing a systematic approach for designing, visualizing, and documenting the structure and behavior of systems. In the context of educational information systems like SPECTRA, UML serves as a vital tool for ensuring that system requirements are accurately represented and translated into functional designs.

UML is a general-purpose modeling language standardized by the Object Management Group (OMG), widely used to support the specification, design, and documentation of software-intensive systems (Booch, Rumbaugh, & Jacobson, 2005). It comprises a set of diagrams divided into two main categories: structural diagrams (e.g., class, component, deployment diagrams) and behavioral diagrams (e.g., use case, sequence, activity diagrams). These diagrams provide different perspectives and levels of abstraction in system development (Fowler, 2004).

According to Dennis, Wixom, and Tegarden (2015), UML helps bridge the gap between system analysts and developers by offering a visual method to express system functionality and data flow. This becomes particularly beneficial for complex systems like SPECTRA, where collaboration among stakeholders—such as developers, curriculum implementers, and administrators—is crucial.

In educational settings, UML has been successfully used to model systems for student information management, performance tracking, and learning analytics. For instance, Koutsopoulos and Avramidis (2011) highlighted how UML-based modeling improves the alignment between educational policy requirements and system functionalities. In the development of academic monitoring systems, use case and activity diagrams provide clarity on user roles and system processes, allowing for efficient requirement gathering and validation.

A study by Karunaratne et al. (2016) demonstrated the effectiveness of UML in modeling e-learning and school management platforms, where sequence and class diagrams helped define relationships between users, modules, and data. These modeling tools contributed to the robustness, maintainability, and scalability of the systems.

For a system like SPECTRA, which integrates reporting, analytics, and performance monitoring within a school division, UML is instrumental in capturing and refining functional and non-functional requirements. Use case diagrams can clearly define user roles (e.g., school heads, division supervisors, CID personnel), while activity diagrams help visualize workflows such as data submission, consolidation, and reporting. Class diagrams allow designers to specify data models related to school performance indicators, quarterly SMEA reports, and technical assistance tracking.

Furthermore, incorporating UML in early phases of SPECTRA's development supports ISO 25010-aligned software quality by promoting better maintainability, functional suitability, and understandability (Al-Qutaish, 2010).

The use of UML in system development like SPECTRA enhances communication, early error detection, and system consistency. It supports iterative design and reduces misinterpretation of requirements

(Ambler, 2005). However, challenges include the steep learning curve for non-technical stakeholders and potential overcomplication if not properly scoped.

UML serves as a foundational tool in the design and development of school-based information systems such as SPECTRA. Through its visual modeling capabilities, UML facilitates requirement analysis, system structuring, and behavior modeling, ultimately contributing to the creation of high-quality, user-aligned, and sustainable education management platforms.

1.3 Gaps in Existing Systems

Despite the progress in regards to digital tools, most educational sectors continue to use either archaic systems or poorly designed ones which do not serve their needs satisfactorily. For example, the manual Google Sheets processes are time consuming and error prone making it difficult to handle large datasets. In their study Johnson and Smith (202) and Lemoine et al. (2019) identify these deficiencies as fundamental barriers to effective school monitoring and evaluation.

One of the divisions that faces these challenges greatly is the Schools Division of Surigao City where SMEA reporting is hampered by late submissions of reports and missing actionable insights. A scalable solution that responds to the needs of this division has been offered by SPECTRA which automates tasks and analytics using advanced techniques as well as improving the security ensuring its processes adheres regulatory authorities.

1.4 Synthesis

Data management systems that are efficient, secure and user friendly are essential for proper monitoring, evaluation and adjustment (SMEA) in the education industry. These systems have been realized to have advantages that encompass saving on administration work, increased accuracy in results, as well as quicker decision-making processes. However, the Schools Division of Surigao City has been using manual sharing techniques which basically involve copying files from one device to another device through limited tools like Google Sheets hence leading to delays, errors, and frustration.

The current frameworks do not have important elements such like strong data safety measures, encrypted content or role-based user access rights, that make private information of students vulnerable. They also do not support real-time analysis which consequently delays the time an administrator/school principal takes to make a decision. This regulation is anchored on the laws of the Republic of the Philippines Republic Act No. 9155 and DepEd regulations, which stress the need for regular evaluation which leads to quality education. However, it is impossible to achieve these goals because there is no comprehensive innovative platform.

To address these gaps, SPECTRA has been designed to close gaps that exist through automation, use of advanced analytics, robust data security measures and adoption of user-centric design principles. It has been designed in line with the national/global development paradigm by incorporating Gender and Development (GAD)-responsive analytics for gender equity promotion. Therefore, this system pledges to modernize SMEA, simplify operations and promote inclusive decision-making based on evident-based information.

1.5 Theoretical Framework

This study is anchored on multiple interrelated theories and concepts that support the design, implementation, and evaluation of the proposed School Management and Analytics Platform for Enhanced Consolidation, Tracking Systems, Reporting, and Advanced Analytics (SPECTRA). Specifically, the study draws upon General Systems Theory (von Bertalanffy, 1968), Information Processing Theory

(Atkinson & Shiffrin, 1968), the Lifecycle Concept grounded in the Records Continuum Model (Upward, 1996), Deming's Theory of Continuous Improvement (Deming, 1986), and the Rapid Application Development (RAD) methodology (Martin, 1991). These theoretical and conceptual underpinnings provide a comprehensive framework to support the transformation of the Schools Monitoring, Evaluation, and Adjustment (SMEA) reporting process in the Schools Division of Surigao City from fragmented, manual procedures—such as the use of Google Sheets—into an integrated, data-driven, and automated system. Through this theoretical lens, the SPECTRA system is positioned not only as a technical innovation but also as a strategic tool that addresses gaps in data management, facilitates real-time analytics, and empowers school leaders with evidence-based decision-making capabilities.

General Systems Theory (von Bertalanffy, 1968) conceptualizes organizations as interconnected systems composed of interdependent parts. Applied to SPECTRA, this perspective emphasizes seamless communication between the Schools Division Office (SDO), school heads, and curriculum personnel. The platform acts as a digital subsystem enabling information exchange and real-time reporting that enhance organizational performance and coherence.

Information Processing Theory (Atkinson & Shiffrin, 1968) supports the system's ability to handle, store, and organize vast amounts of school performance data. SPECTRA aids human cognition by presenting data in visual and structured formats, thereby improving interpretation, comparison, and the formulation of appropriate interventions based on actual school conditions.

The Lifecycle Concept, as applied in data management, describes the process of data from its creation, storage, and use to eventual disposal. Grounded in the Records Continuum Model (Upward, 1996), this approach ensures that data is continuously accessible, contextually meaningful, and preserved for future reference. Through SPECTRA's structured data architecture and integrated school databank, the system upholds data integrity, longevity, and security throughout its entire lifecycle.

The development of SPECTRA adheres to the Rapid Application Development (RAD) model (Martin, 1991), which promotes iterative prototyping and active user involvement to produce functional systems in shorter timeframes. RAD allows developers to respond quickly to feedback from school administrators and division personnel, ensuring the platform evolves with user needs and practical requirements of SMEA reporting.

Aligned with Deming's Theory of Continuous Improvement (Deming, 1986), SPECTRA supports the cycle of planning, implementing, monitoring, and adjusting strategies based on actual performance data. Through quarterly data tracking and real-time analytics, the system enables schools and the division office to continuously refine practices and enhance educational outcomes.

To ensure the system's quality and sustainability, SPECTRA is evaluated using the ISO/IEC 25010 software quality model (ISO/IEC, 2011), which comprises eight core characteristics. Functional Suitability ensures that the system performs required tasks accurately and completely. Performance Efficiency evaluates responsiveness and resource optimization, while Compatibility assesses the system's ability to integrate with existing tools and infrastructure. Usability emphasizes intuitive design and user experience. Reliability ensures stability over time, and Security safeguards sensitive educational data. Maintainability relates to how easily the system can be updated or fixed, and Portability supports adaptability across various platforms and devices. These standards collectively guarantee that SPECTRA is a robust, secure, and scalable system aligned with educational technology best practices.

1.6 Statement of the Problem

This study aims to develop and evaluate the SPECTRA system as an innovative solution to improve the SMEA reporting process in the Schools Division of Surigao City. Specifically, it seeks to answer the following questions:

1. What is the demographic profile of the participants in terms of:
- Age;
- Gender; and
- Position?
2. What is the level of compliance of the developed SPECTRA system with the ISO/IEC 25010:2011 software quality model in terms of:
- Functional Suitability;
- Performance Efficiency;
- Compatibility;
- Usability;
- Reliability;
- Security;
- Maintainability; and
- Portability?
3. Is there a significant difference in the participants' assessment of the system's compliance with the ISO/IEC 25010:2011 quality standards when grouped according to their profile variables?

2. Methods

2.1 Research Design

This study employed a descriptive-developmental research design to address the specific monitoring, evaluation, and reporting needs of the Schools Division of Surigao City. As defined by Seels and Richey (1994), developmental research is a systematic process aimed at designing and developing solutions that meet particular needs through careful analysis and evaluation. In this case, the solution was the development of the School Performance and Enhanced Consolidation, Tracking, Reporting, and Analytics System (SPECTRA), a system specifically created to improve the handling of school data and facilitate better decision-making. To ensure a structured and systematic development process, the study utilized the Systems Development Life Cycle (SDLC) approach, which includes the phases of planning, analysis, design, development, testing, and implementation. During the planning and analysis phases, consultations were conducted with key stakeholders to identify system requirements. The design phase involved creating the system architecture and user interface based on identified needs. In the development phase, the Rapid Application Development (RAD) model—a variant of SDLC—was employed to enable fast prototyping and iterative refinement through user feedback (Pressman, 2014).

The system was then tested and validated by end-users, including school administrators, district supervisors, and members of the Curriculum Implementation Division (CID), who evaluated its functionality and usability. To measure its effectiveness, a descriptive-evaluative design was used, focusing on how the system aligned with ISO/IEC 25010:2011 software quality standards. As Creswell (2014) notes, descriptive research provides a comprehensive understanding of a phenomenon, allowing for the summarization of system attributes without implying causality. Overall, the combination of SDLC and RAD methodologies, along with descriptive-evaluative assessment, ensured that SPECTRA was

developed systematically and validated effectively to meet the actual needs of its users.

2.2 Research Environment

The study is conducted at the Department of Education in a city division located on M. Ortiz Street in Barangay Washington. Established in 1974 through an integrated reorganization plan, this division became a separate entity from the larger provincial division. Originally situated near the City Hall, the division later moved to a two-storey building near a local pilot school, which remained until October 10, 2013. It is currently located within the compound of a central elementary school. The division is committed to its mission of providing quality education and has a solid foundation for assessing the integration of innovative tools and systems, including the proposed project aimed at improving Schools Monitoring, Evaluation, and Adjustment (SMEA) processes, which serves as the focus of this study.

2.3 Participants

Participants in this research are end users of the developed system which comprised school heads and personnel working at the Curriculum Implementation Division (CID) located at the Department of Education (DepEd) in Surigao City. There are 87 school heads, 10 district supervisors,11 IT expert and 20 CID personnel who involve in assessing the system's effectiveness.

Stratified random sampling technique is applied in order to get respondents. This entailed dividing the participants into two main groups, school heads and CID personnel, then randomly selecting individuals from each group so as to achieve equality. Approximately half of them, i.e., 50% or 25 persons, were identified from the group as shown in Table 1 below. The use of this technique ensured that school heads, and CID personnel provided feedback on issues concerning functionality, usability, and overall performance of the system, resulting in well-rounded input for this study. Specifically, school heads were selected from both mainland and island areas, provided they had access to internet connectivity, since the SPECTRA system operates through a web-based platform.

Table 1. Distribution of Participants

City Division Offices	No. of Office Personnel	Sample
Curriculum Implementation Division	**23**	**11**
School Heads	**87**	**24**
IT Expert	**10**	**5**
Total	**59**	**40**

2.4 Research Instrument

In this study, an evaluation instrument was adapted based on the ISO/IEC 25010:2011 standards. This structured approach allowed for a comprehensive assessment of the system's performance and user experience, ensuring that all essential quality attributes—such as functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability—were thoroughly examined. By employing this standard, the study aimed to provide a detailed analysis of how well the system meets the defined criteria for quality and user satisfaction.

2.5 Ethics and Data Gathering Procedure

In To ensure the ethical integrity of this research and the responsible development of the School

Performance and Enhanced Consolidation, Tracking, Reporting, and Analytics System (SPECTRA), a structured four-phase methodology grounded in the Rapid Application Development (RAD) model was followed. Each phase was guided by ethical principles and strictly adhered to the provisions of Republic Act 10173, or the Data Privacy Act of 2012 (DPA), which governs the lawful collection, handling, and protection of personal and sensitive information in the Philippines. Prior to the commencement of the study, formal approval was secured from the Schools Division Superintendent through a letter of request outlining the objectives, scope, and intended use of the SMEA template for system design. Additionally, all participants involved in data collection and system development—including school heads, district supervisors, and Curriculum Implementation Division (CID) staff—were informed of their rights as data subjects under the DPA, including the right to be informed, object, access, rectify, and erase their data. Their informed consent was obtained voluntarily and documented properly.

A. Requirement Planning Phase

In this stage, the study identified the problem, defined the objectives and scope, and determined the tools needed for the system. Ethical practice was observed by securing informed consent from participants, ensuring they clearly understood the purpose of the study, the type of data to be collected, and their rights regarding participation. Only the minimum necessary data was gathered, following the principle of data minimization under the DPA. Confidentiality was strictly maintained during interviews and meetings, and collected data were anonymized and stored securely to protect personal information. Stakeholder consultations were conducted in private settings to ensure transparency, respect, and data security.

B. Prototyping Phase

In this phase, a working model of the system was developed based on the requirements identified. Ethical standards were reinforced by continuously engaging end-users for feedback while ensuring transparency at every iteration. Participants were made aware of the purpose of usability testing and their feedback was gathered voluntarily and without pressure. The system's design followed the "privacy by design and by default" principle, incorporating data protection features such as user authentication and access control. Any sensitive information disclosed during this phase was protected, and all records of input and feedback were handled with strict confidentiality in accordance with the DPA.

C. Testing Phase

During the testing process, the prototype was subjected to field testing in actual school settings. Prior to any test activity, stakeholders were fully informed about the procedures, objectives, and potential risks. Ethical safeguards were applied to ensure participants' autonomy, including the option to decline participation at any point. Data collected during testing—such as feedback forms or system usage logs—were anonymized and stored securely. Emphasis was placed on both the technical and usability aspects of the system to ensure that feedback from users could inform continuous improvement. No personally identifiable information was disclosed, and data processing protocols were strictly followed to ensure compliance with the DPA.

D. Deployment and Implementation Phase

Finally, the Deployment and Implementation Phase involved rolling out the SPECTRA system to participating schools. Orientation sessions and user guides were provided to ensure that participants fully understood how to use the system responsibly and securely. Ethical practices were upheld through regular monitoring, post-deployment interviews, and feedback collection to evaluate the system's impact and identify areas for enhancement. The system remained compliant with data privacy regulations by ensuring secure logins, access management, and encrypted data storage. Feedback mechanisms respected the

anonymity of users and helped maintain an ethical feedback loop for continual system refinement.

Throughout all phases, this research remained committed to the core ethical principles of respect, beneficence, non-maleficence, justice, and accountability. It upheld the rights and welfare of all participants, ensuring confidentiality, voluntary participation, transparency, and compliance with the Data Privacy Act. The study also applied data protection principles such as lawful processing, purpose limitation, and secure storage and disposal, thereby fostering an environment of trust, integrity, and professional responsibility throughout the development and deployment of the SPECTRA system.

2.6 Data Analysis

To address the research objectives and adequately evaluate the effectiveness, quality, and compliance of the SPECTRA system in streamlining SMEA reporting, a combination of descriptive and inferential statistical tools was employed. These tools ensured a rigorous examination of participant demographics, software performance, and system validity in alignment with the ISO/IEC 25010:2011 software quality model.

Frequency Count and Percentage. These descriptive statistics were applied to quantify and present the demographic profile of the, specifically in terms of age, gender, and position. This facilitated a clear understanding of the respondent distribution, which is essential for contextualizing system feedback and identifying user-specific system needs.

Mean and Standard Deviation. These measures of central tendency and dispersion were utilized to assess the level of compliance of SPECTRA with the ISO/IEC 25010:2011 software quality attributes (SOP No. 2), and the validity of the system as evaluated by IT experts (SOP No. 4). This statistical approach provided a numerical summary of participants' assessments regarding the system's functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability, as well as the clarity and technical soundness of the platform.

Kruskal-Wallis Analysis of Variance (ANOVA). Given the ordinal nature of Likert-scale data and potential non-normal distribution, the Kruskal-Wallis ANOVA, a non-parametric statistical test, was used to determine whether significant differences exist in the evaluation of the system's quality attributes when grouped according to profile variables such as age, gender, and position (SOP No. 3). This analysis provided insights into the consistency and perceived effectiveness of the system across different user demographics.

3. Results

Profile of Participants

Table 2 details the profile of the 40 participants. Most respondents were school heads (55%), with the majority being female (65%) and aged between 31 to 50 years. This diverse representation strengthens the reliability of the system evaluation from various educational stakeholders.

Table 2. Profile of Participants

Profile		f(n-40)	Percent
Age	21-30	5	12.5
	31-40	13	32.5
	41-50	12	30.0
	51 and above	10	25.0
Sex	Male	14	35.0
	Female	26	65.0

Position	Teacher | SMEA Coordinator	4	10.0
	School Head	22	55.0
	Education Program Supervisor	12	30.0
	Division Personnel	2	5.0

Software Quality Attributes of SPECTRA

To ensure the developed SPECTRA system meets globally recognized standards for software quality, this study adopted the ISO/IEC 25010:2011 framework in evaluating its core attributes. ISO 25010 outlines a comprehensive model for assessing the quality of software products, encompassing key characteristics such as functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. These attributes serve as benchmarks for measuring the system's effectiveness in fulfilling user needs, operating reliably under defined conditions, and adapting to various environments. The following tables present the evaluation results of SPECTRA's compliance with each of these quality attributes, as perceived by the identified respondents during the system testing and validation phase.

As shown in Table 3, with an average mean of 4.98, participants strongly agreed that the system meets functional suitability standards. SPECTRA effectively support user objectives, allows efficient data processing, and produces accurate reports, indicating its high functional relevance for school-based planning and reporting.

Table 3. Functional Suitability of SPECTRA

Statement	Mean	SD	VI	QD	Interpretation
1. The system covers all the user's objectives and specified the tasks needed for SMEA data consolidation, analysis, and reporting.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
2. SPECTRA allow users to encode, track, and consolidate school data efficiently.	4.95	0.22	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
3. The features of SPECTRA are complete and aligned with the workflow of school and division personnel.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
4. The system accurately provides the correct result, reports and analytics required for decision-making and planning.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.

Average	**4.98**	**0.09**	**Strongly Agree**	**Very Great Extent**	The SPECTRA system fully meets all key aspects of SMEA reporting.

Table 4 presents the evaluation of the system's performance efficiency, with an overall mean of 4.98. Respondents reported fast response times, reliable system performance under simultaneous use, and quick data processing, suggesting the system is efficient even in high-demand scenarios.

Table 4. Performance Efficiency of SPECTRA

Statement	Mean	SD	VI	QD	Interpretation
5. The system responds quickly during data input, saving, and report generation.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
6. The system quickly loads dashboards, forms, and data visualizations, and generates summary reports and graphs without long waiting times.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
7. SPECTRA maintain consistent performance even when accessed by multiple users simultaneously.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
8. The system's maximum limits of parameters meet the user's requirements.	4.95	0.22	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
Average	**4.98**	**0.09**	**Strongly Agree**	**Very Great Extent**	The SPECTRA system fully meets all key aspects of SMEA reporting.

As illustrated in Table 5, the average mean of 4.93 reflects strong agreement that the system is compatible across devices, operating systems, and integrates well with existing DepEd tools. This confirms SPECTRA's flexibility and adaptability across various platforms.

Table 5. Compatibility Attribute of SPECTRA

Statement	Mean	SD	VI	QD	Interpretation
9. The system works smoothly across different devices (desktop, tablet, mobile).	4.93	0.27	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.

10. The system can export or interact with other systems/tools commonly used in DepEd.	4.90	0.38	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
11. The system is accessible on any device with an internet connection	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
12. User experience remains consistent across different operating systems and device brands.	4.90	0.44	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
Average	**4.93**	**0.19**	**Strongly Agree**	**Very Great Extent**	The SPECTRA system fully meets all key aspects of SMEA reporting.

Table 6 reveals a high usability rating with an average mean of 4.98. Participants found the system easy to learn and navigate, with helpful built-in support features. This suggests that even users with basic digital literacy can interact effectively with SPECTRA.

Table 6. Usability of SPECTRA

Statement	Mean	SD	VI	QD	Interpretation
13. SPECTRA is easy to learn and use, even for users with basic digital skills.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
14. The system's menus, labels, chatbot assistance, and other help features within the system are clear, responsive, and helpful in guiding the user.	4.95	0.22	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
15. Navigation through the system is intuitive and straightforward.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
16. The system allows specified users to achieve learning goals effectively, and efficiently and have freedom from risk and satisfaction in a specified context.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
Average	**4.98**	**0.08**	**Strongly Agree**	**Very Great Extent**	The SPECTRA system fully meets

					all key aspects of SMEA reporting.

In Table 7, the reliability of SPECTRA was rated with a mean of 4.92. Respondents strongly agreed that the system operates with minimal disruptions and maintains accessibility and functionality, indicating dependable performance over time.

Table 7. Reliability of SPECTRA

Statement	Mean	SD	VI	QD	Interpretation
17. The system operates smoothly without unexpected errors, delays, or interruptions.	4.90	0.38	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
18. The system is operational and accessible when required for use.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
19. The system can operate as intended despite the presence of hardware and software faults.	4.93	0.27	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
20. The system experiences minimal downtime and avoids extended maintenance disruptions.	4.88	0.33	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
Average	**4.92**	**0.23**	**Strongly Agree**	**Very Great Extent**	The SPECTRA system fully meets all key aspects of SMEA reporting.

In Table 8, the system scored a strong average mean of 4.98 in terms of security. Respondents affirmed that access is restricted to authorized users and that data is protected through secure measures, reflecting a high level of trust in system security.

Table 8. Security Attribute of SPECTRA

Statement	Mean	SD	VI	QD	Interpretation
21. The system provides unique account to each end user.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
22. The system can be accessed only by the authorized users (e.g., school head, district supervisor and division personnel).	4.95	0.22	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.

23. The system is secured and protected in terms of data transmission.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
24. SPECTRA ensure the protection of sensitive school data through robust security measures and role-based access controls.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
Average	**4.98**	**0.07**	**Strongly Agree**	**Very Great Extent**	The SPECTRA system fully meets all key aspects of SMEA reporting.

Table 9 reports an average mean of 4.99, showing strong agreement that the system is highly maintainable. Users believe it supports regular updates, has a modular structure for fixing issues, and allows controlled setting adjustments by authorized personnel.

Table 9. Maintainability of SPECTRA

Statement	Mean	SD	VI	QD	Interpretation
25. The system is designed to support improvements and updates as needed.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
26. The system issues, bugs, or errors can be fixed without affecting other functions.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
27. SPECTRA's modular architecture enables independent updates to individual components.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
28. The system allows modification of settings by authorized person.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
Average	**4.99**	**0.04**	**Strongly Agree**	**Very Great Extent**	The SPECTRA system fully meets all key aspects of SMEA reporting.

As shown in Table 10, respondents rated SPECTRA highly in terms of portability, with a mean of 4.96. They agreed that it retains functionality and appearance across platforms and browsers, and can be redeployed with ease, emphasizing its versatility and user-friendliness.

Table 10. Portability of SPECTRA

Statement	Mean	SD	VI	QD	Interpretation
29. SPECTRA can be accessed on various operating systems and platforms.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
30. The system retains its functionality and display quality across different browsers or devices.	4.98	0.16	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
31. The system can communicate or interact with other system or application	4.85	0.48	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
32. The system can be reinstalled or redeployed on different environments without extensive reconfiguration.	5.00	0.00	Strongly Agree	Very Great Extent	The SPECTRA system fully meets all key aspects of SMEA reporting.
Average	**4.96**	**0.13**	**Strongly Agree**	**Very Great Extent**	The SPECTRA system fully meets all key aspects of SMEA reporting.

Comparisons of Quality Attributes of SPECTRA by Profile of Participants

To determine whether user perceptions of SPECTRA's software quality vary across different demographic and professional backgrounds, the study analyzed the evaluation results based on the participants' profiles, including age, gender, and position. By comparing the ratings of the system's quality attributes—namely functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability—across these groups, the study aims to identify potential differences in user experience and satisfaction. This analysis provides valuable insights into the inclusivity, adaptability, and general usability of the SPECTRA system across diverse user categories. The results of these comparisons are presented in the following tables.

Table 11. Difference on Quality Attributes of SPECTRA based on Profile of Participants

Profile	Indicator	Chi-Square	p-value	Decision on Ho	Inter'n
Age	Functional Suitability	4.31	0.23	Not Rejected	Not Significant
	Performance Efficiency	4.04	0.26	Not Rejected	Not Significant
	Compatibility	2.96	0.40	Not Rejected	Not Significant
	Usability	2.07	0.56	Not Rejected	Not Significant
	Reliability	0.62	0.89	Not Rejected	Not Significant
	Security	2.33	0.51	Not Rejected	Not Significant
	Maintainability	7.00	0.07	Not Rejected	Not Significant

	Portability	1.88	0.60	Not Rejected	Not Significant
Sex	Functional Suitability	0.01	0.93	Not Rejected	Not Significant
	Performance Efficiency	1.70	0.19	Not Rejected	Not Significant
	Compatibility	0.052	0.82	Not Rejected	Not Significant
	Usability	2.33	0.13	Not Rejected	Not Significant
	Reliability	0.48	0.49	Not Rejected	Not Significant
	Security	1.70	0.19	Not Rejected	Not Significant
	Maintainability	1.86	0.17	Not Rejected	Not Significant
	Portability	0.62	0.43	Not Rejected	Not Significant
Position	Functional Suitability	1.99	0.57	Not Rejected	Not Significant
	Performance Efficiency	2.58	0.46	Not Rejected	Not Significant
	Compatibility	1.28	0.73	Not Rejected	Not Significant
	Usability	3.55	0.31	Not Rejected	Not Significant
	Reliability	1.07	0.78	Not Rejected	Not Significant
	Security	2.59	0.46	Not Rejected	Not Significant
	Maintainability	7.41	0.06	Not Rejected	Not Significant
	Portability	3.07	0.38	Not Rejected	Not Significant

Table 11 presents the differences in the quality attributes of SPECTRA when analyzed according to the participants' profiles, specifically their age, sex, and position. The statistical results reveal that for the variable age, none of the quality indicators showed statistically significant differences. All p-values exceeded the standard 0.05 level, with the lowest being 0.07 for maintainability, which is still above the threshold for significance. The null hypothesis was not rejected in all instances, indicating that age does not significantly affect perceptions of SPECTRA's quality attributes.

Similarly, when grouped according to sex, the results also showed no significant differences across all quality indicators. The p-values ranged from as low as 0.13 for usability to as high as 0.93 for functional suitability, reaffirming the conclusion that gender does not play a significant role in the assessment of the system's quality. In all cases, the null hypothesis was again not rejected.

When examining the participants' position, no significant differences were observed either. Although the indicator maintainability approached the 0.05 significance level with a p-value of 0.06, it still did not reach statistical significance. The rest of the indicators had even higher p-values, confirming the lack of a statistically difference on the perceived quality attributes of SPECTRA based on the position of the participants.

4. Discussions

This study was conducted to develop and evaluate the School Performance and Enhanced Consolidation, Tracking, Reporting, and Analytics System (SPECTRA) as a digital solution to improve the SMEA reporting process in the Schools Division of Surigao City. The discussion of the results is organized based on the research objectives.

The demographic profile of the participants revealed that the majority were female, aged 31 to 40 years, and held the position of School Head. This demographic composition is consistent with the actual structure of school leadership within the division, highlighting that feedback was collected from professionals who are directly involved in school-level planning and performance monitoring. Their active roles in the SMEA

process provided valuable insights into the system's usability and relevance.

As to the evaluation of SPECTRA using the ISO/IEC 25010:2011 software quality model indicated that the system achieved a very great extent of compliance across all eight quality attributes: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. Functionally, SPECTRA met the reporting and data tracking requirements necessary for schools and the division office. In terms of performance efficiency, the system remained stable and responsive even with high user traffic and data volume. Compatibility was evident in its seamless functionality across different devices and platforms, ensuring accessibility for all users. Usability was a standout feature, with users reporting a smooth, intuitive experience that required minimal technical expertise. Reliability was confirmed by the system's stable operation during testing, while security measures such as data encryption and user authentication protected sensitive educational data. The modular design of the system contributed to its maintainability, allowing for easy updates and adjustments. Furthermore, the system's portability enabled effortless deployment across schools with diverse infrastructure setups. These high ratings across all quality attributes confirm the system's readiness for full-scale implementation and its alignment with technical best practices.

Findings showed no statistically significant differences in how participants assessed SPECTRA's quality attributes when grouped according to age, gender, or position. This result suggests a consistent user experience regardless of demographic differences, which reinforces the system's inclusive and user-centered design. The absence of variance in feedback across profiles indicates that SPECTRA successfully met the expectations of all user groups and demonstrates its adaptability and wide acceptability in the school setting.

The study also highlighted user-driven enhancements that were made following initial deployment. Notably, access to analytics features was extended to school heads, who were previously not included in this functionality. This adjustment empowered school leaders to analyze performance data directly and make timely, evidence-based decisions. This enhancement reflects the system's responsiveness to user feedback and its role in strengthening the data governance capacity of individual schools.

Overall, the findings affirm that SPECTRA is a robust, high-quality, and inclusive system that effectively addresses the gaps in SMEA reporting. Its compliance with international software standards, positive evaluation from key education stakeholders, and integration of improvements based on practical feedback position it as a valuable digital platform for enabling data-driven educational planning and decision-making in the Schools Division of Surigao City.

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