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AccoSoft: An accounting system for an onion cooperative using multi-paradigm programming languages

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ABSTRACT

This study aimed to develop an accounting system for an onion cooperative in Nueva Ecija, called "ACCOSOFT," which stands for Accounting Software. ACCOSOFT is an analytical accounting tool that utilizes various financial indicators to track and record KASAMNE's budget and financial statements. The system is designed to present financial information in multiple formats, based on the needs of accounting staff, rather than simply balancing accounts. It also supports the cooperative with account management, disbursement, collection, journal entries, and report generation, including trial balance, balance sheet, and income statement. The researchers used multi-paradigm programming languages, enabling them to select the best programming style and language features for building the system. Specifically, they employed Visual Basic.Net (Microsoft Visual Studio 2010 Express) as the front-end language and HTML, CSS, JavaScript, and PHP for report generation. MariaDB, run through XAMPP, was used for the database.

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1. Introduction

The agriculture sector consistently contributes to the Gross Domestic Product (GDP) of the Philippines. Many people will be able to take advantage of the available resources and turn them into productive tools to improve the quality of human life because of the Industrial Revolution 4.0. The fourth industrial revolution is the intelligent industry, in which companies are converted into better versions to achieve the greatest potential business outcomes. It also encompasses not just the agriculture sector but the information technology (IT) sector as well (Ferreira et al., 2021; Xu et al., 2018).

Companies can now use computers to accomplish tasks that were formerly performed manually because of technological improvements (Luciano, 2020). Accounting systems that were formerly carried out by hand can now be done with the assistance of computers. As a result, advancements in information technology have made cost and management accounting systems easier to execute.

The aim of this study is to develop an analytical accounting system that will assist the KASAMNE Cooperative in systematizing its accounting procedure.

KASAMNE SMKB, INC. (KAtipunan ng SAmahang Magsisibuyas ng Nueva Ecija) is a secondary cooperative originally composed of 64 onion-producing primary cooperatives in Nueva Ecija, located at Brgy. Caballero, Palayan City, Nueva Ecija. A non-profit business organization that offers cold storage services, trucking, and other services related to cold storage. It was organized and registered in 1989 under the Bureau of Agricultural Cooperative Development. In 1991, the Cooperative Development Authority confirmed its registration and was re-registered on December 02, 2009, under Republic Act 9520, known as "The Cooperative Code of 2008" (PCC, 2017). Their warehouse storage facility can store 238,000 bags of bulb crops such as varieties of onions and garlic or about 6,426 metric tons. It provided services such as trucking, handling (classification process and repacking), and warehouse cold storage service. The proposed system covers account management, disbursement, collection, journal entries, and reports preparation such as trial balance, balance sheet, and income statements.

The basic objective of financial reporting is the provision of information useful for assessing a company's performance and prospects. Low-quality financial reporting contains inaccurate, misleading

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information that may result in losses and reduced confidence in corporate governance mechanisms. Emerging globalization requires business entities to develop means of processing financial information accurately and speedily for users' decision-making. Research shows that a well-implemented AIS can enhance the financial performance of organizations by providing accurate financial statements and facilitating better resource management. For example, research conducted on banks reveals that AIS plays a crucial role in achieving financial sustainability by improving the reliability of financial reporting and decision-making processes (Olufemi et al., 2021).

Studies have also shown a positive correlation between the use of information communication technology (ICT) in accounting systems and improved organizational outcomes. This relationship is crucial for businesses aiming to remain competitive in increasingly digital environments (Thottoli, 2021).

The literature emphasizes that AIS significantly aids managerial decision-making by providing timely and accurate financial data. Effective AIS can streamline processes, reduce errors, and enhance the quality of financial reports, thereby supporting strategic planning and operational control. For instance, the study by Wahyuni (2023) indicated that AIS improves decision-making capabilities and internal controls in small and medium enterprises (SMEs) (Wahyuni, 2023).

2. Methodology

To design the system, the researchers adopted the agile method known as the scrum technique. Scrum software development is a lightweight software development technique that emphasizes small time-boxed sprints of new functionality that are merged into an integrated product baseline (Luciano, 2020). This technique focuses on client engagement, feedback, and modifications. The system was analyzed using the results of the series of interviews conducted by the researchers. All the important information acquired from the interviewees was carefully considered and given top priority in the development of the system prototype.

In designing the system, the researchers used multiple languages; hence, they adopted the term multi-paradigm language. A multi-paradigm language provides a framework in which programmers can work in a variety of styles, freely intermixing constructs from different paradigms (Van Roy et al., 2020). Particularly, they have used the following languages: VB.Net (Microsoft Visual Studio 2010 Express), HTML, CSS, JavaScript, and PHP scripting languages. MariaDB using XAMPP was also utilized. VB.Net is a simple, modern, object-oriented computer programming language developed by Microsoft to combine the power of .NET Framework and the common language runtime with the productivity benefits that are the hallmark of Visual Basic. HTML is a language that provides the basic structure of websites, which is enhanced and modified by other technologies like CSS and JavaScript. CSS is used to control presentation formatting and layout. JavaScript is used to control the behavior of different elements. On the other hand, Prokofyeva and Boltunova (2017) described PHP "as a server scripting language and a powerful tool for making dynamic and interactive Web pages."

MariaDB is an open-source relational database management system (RDBMS) that is a compatible drop-in replacement for the widely used MySQL database technology. It was designed as a software fork of MySQL by developers who played key roles in building the original database. The system has the following features:

- Preparation of accounting documents: ACCOSoft provides its users with accounting documents like cash memos, bills, invoices, and accounting vouchers such as cash vouchers, received vouchers, disbursement vouchers, and journal vouchers.
- Recording of transactions: Everyday transactions of KASAMNE shall be recorded with the help of ACCOSoft. Every account and transaction shall be assigned a unique code where the grouping of accounts is done in the first stage. This process simplified the recording of transactions.
- Preparation of trial balance and other financial statements: After recording the transactions, the system shall automatically transfer the data into ledger accounts. A trial balance can also be generated by the system to check the accuracy of records. With the help of trial balance, the system can also provide a statement of comprehensive income and a statement of financial position.
- Respondents: The respondents of this study were composed of two (2) KASAMNE cooperative personnel and five (5) IT Experts from selected offices and institutions in Nueva Ecija, Philippines. The IT experts were those who assessed the technical quality of the system based on the ISO/IEC Software Quality criteria. They were involved in all phases of the development, especially in the designing and testing of the system.
- Sample and Sampling Procedure: The purposive sampling procedure was used in selecting the respondents for this study. This technique was employed because of the limited number of respondents who can serve as primary sources of information. In this study, the KASAMNE personnel were purposively chosen based on their need and ability to assess the quality of the system. The IT experts were likewise purposively chosen based on their technical knowledge of the system functionalities and technicalities.
- Research Instruments: The researchers used an assessment questionnaire as a tool for collecting data. It was crafted based on the ISO/IEC 25010 Software Product Quality Standard. It has 2 parts; part I was designed for the IT experts to assess the technical quality of the system based on the

criteria of ISO 25010. Part II dealt with the end-users' assessment of AccoSoft where they rated the product quality standard of the system based on the following criteria: (1) functional suitability, (2) performance efficiency, and (3) usability.

- Response and Scoring Mode: The items in the questionnaire were rated and scored according to the hereunder scale and criteria presented in Table 1.

Table 1 Interpretation of the summary of results of ISO 25010 software product quality standards

Interval	Verbal description	Verbal interpretation
3.25 – 4.00	Highly functional/highly efficient/highly compatible/ highly usable/highly reliable/ highly secured/ highly maintainable/ highly portable	Excellent
2.50 – 3.24	Functional/efficient/compatible/ usable/reliable/secured/ maintainable/portable	Satisfactory
1.75 – 2.49	Needs improvement	Needs improvement
1.00 – 1.74	Poor	Poor

- Requirements Analysis: The accounting-related procedures in KASAMNE are done manually, as discussed in the previous sections. This provides proponents with the interest to create a system that will aid in improving the current technique used by this enterprise. The proponents analyzed all the system's functional and non-functional requirements based on the information obtained from the interviewees.
- Requirements Documentation: To collect the needed data, the researchers employed the following data collection methods:

- Interview: An interview is conducted as the primary data-gathering procedure. The proponents chose this technique to get detailed data about respondents' ideas and experiences as far as the accounting system is concerned. To facilitate the interview the proponents first identified the persons whom they are going to interact with.

These individuals were interviewed to obtain the most comprehensive data and information that the proponents needed for the design and development of the system prototype. Following the interview, the proponents compiled a list of features and requirements for the system to be constructed by summarizing and analyzing the information they gathered.

- Observation: Observation is a method of collecting facts in a systematic manner. The proponents used this data-gathering technique to know exactly how the cooperative's personnel are performing their accounting transactions. It was utilized to systematically collect data on how the cooperative's personnel conducted their accounting transactions. This method provided a real-world view of existing processes, allowing the researchers to identify inefficiencies and areas for improvement.
- Internet Research: Any action in which a topic is recognized, and an effort is made to actively obtain information to increase understanding is considered Internet research. Hundreds of thousands of pages about this subject could be found by searching the internet. The researchers conducted extensive online research to supplement their findings from interviews and observations. This involved exploring various resources to gain additional insights into accounting practices and systems, which informed the analysis and design of the proposed system (Korompis et al., 2023).

3. Results and discussion

3.1. Design of software/systems

The design of the accounting system for KASAMNE is crucial for enhancing the efficiency and effectiveness of its accounting processes. The use case diagram serves as a foundational tool to illustrate the interactions between various users and the system, indicating the specific functionalities available to each role as shown in Fig. 1.

The diagram categorizes users into distinct roles: system administrator, manager, cashier, and accounting staff. Each role has specific access rights and responsibilities, which are critical for maintaining security and operational efficiency within the system.

- The System Administrator role has the highest level of access, allowing the administrator to manage user accounts, control access permissions, and perform database backups and restorations. This level of control is essential for maintaining the integrity and security of the system, as noted in literature emphasizing the importance of robust user management in accounting systems.
- The Branch Manager has access to financial statements, purchases, and expenses modules. This access is vital for strategic decision-making and financial oversight, aligning with findings that highlight the necessity of real-time financial data for effective management.
- Cashier and Accounting Staff roles are typically involved in daily transactions and record-keeping. Their access is designed to facilitate operational tasks while ensuring that sensitive financial data is protected from unauthorized access. The segregation of duties is a best practice in accounting systems to minimize the risk of fraud and errors.

The use case diagram also outlines the specific functions available to each user role, which can include:

- Data Entry: Cashiers and accounting staff can enter transactions, ensuring that all financial activities are recorded accurately and promptly.
- Reporting: Managers can generate reports to analyze financial performance, which is critical for informed decision-making. The ability to access comprehensive reports supports the findings that computerized systems significantly enhance reporting capabilities compared to manual processes.
- User Management: The system administrator's ability to add or modify user access ensures that only authorized personnel can perform sensitive tasks, aligning with security best practices in information systems.

In summary, the use case diagram not only provides a clear overview of the system's functionalities and user interactions but also serves as a foundation for future research aimed at optimizing accounting practices within KASAMNE and similar organizations. The emphasis on user roles, access control, and system functionality underscores the importance of thoughtful design in achieving operational excellence.

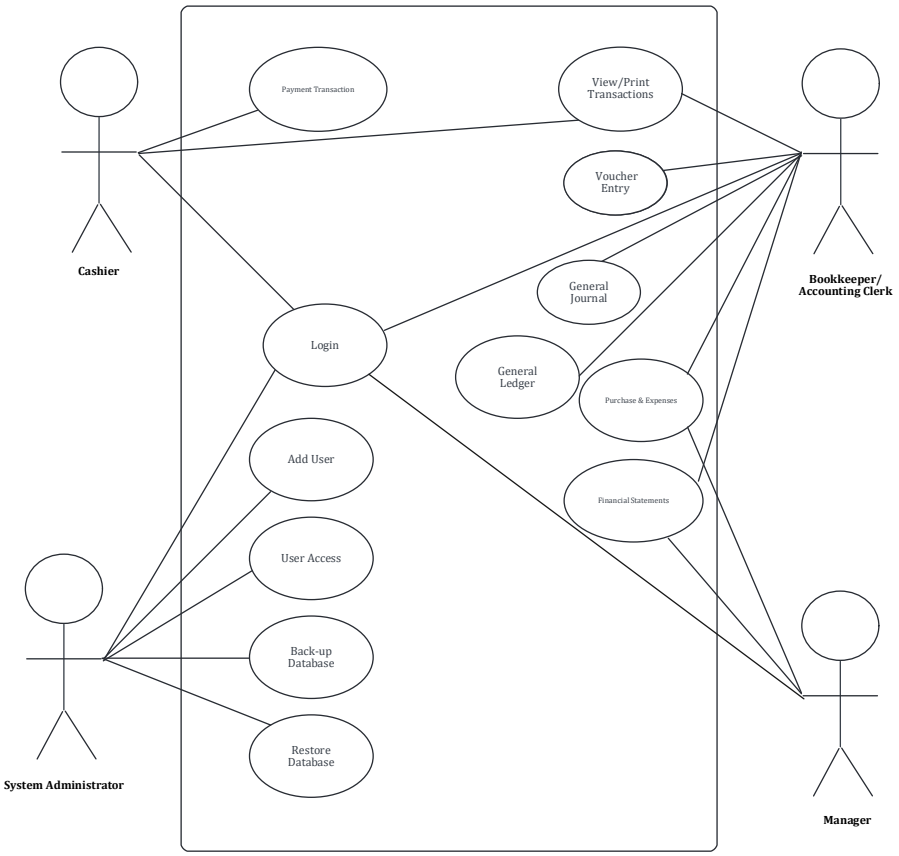

Fig. 1: The system's use case diagram

3.2. Development of the system

The development of the accounting system for KASAMNE involved several key platforms and tools that played crucial roles in creating an effective and user-friendly application. Below is a discussion of these tools in relation to the accounting system, focusing on their functionality and benefits without delving too deeply into technical details.

3.3. Visual studio IDE

Visual Studio is a powerful integrated development environment (IDE) that facilitates the entire software development process. For the accounting system, it provides a centralized platform where developers can write, test, and debug code efficiently. It allows for rapid development of accounting applications by providing features like code completion and debugging tools. This means that developers can quickly implement features such as invoicing, expense tracking, and financial reporting, which are essential for any accounting system. The debugging capabilities also help identify and fix errors early in the development process, ensuring that the final product is reliable. This is particularly important in accounting software, where accuracy is paramount. Visual Studio supports version control, enabling multiple developers to work on the accounting system simultaneously. This collaborative approach can lead to a more robust and feature-rich application.

3.4. Notepad++ text editor

Notepad++ is a versatile text editor that is often used for writing and editing code. While it may not have all the features of a full IDE like Visual Studio, it

is lightweight and efficient for certain tasks. Developers made use of this software to make quick changes to code or configuration files without the overhead of a full IDE. The researchers found it useful for minor adjustments in the accounting system, such as tweaking formulas or updating settings. The syntax highlighting feature also helps developers quickly identify different elements of code, which can reduce errors when working on complex accounting logic.

3.5. PhpMyAdmin

phpMyAdmin is a web-based tool for managing MySQL databases, which are often used to store data for accounting systems. This software allows developers to easily create and manage a database that stores financial records, user information, and transaction data. This is crucial for any accounting system, as it ensures that all data is organized and accessible. It also can execute SQL queries directly through phpMyAdmin which enables the developers to manipulate data efficiently, particularly on tasks such as generating reports or updating records, which is a frequent requirement in accounting.

3.6. XAMPP

XAMPP allows developers to run the accounting system locally, which is essential for testing features before deployment. This ensures that any issues can be resolved in a controlled environment without affecting live operations. By using XAMPP, developers tested how different components of the accounting system interact with each other, such as how user inputs are processed and stored in the database. The combination of Visual Studio, Notepad++, phpMyAdmin, and XAMPP provides a comprehensive toolkit for developing a robust accounting system for KASAMNE. Each tool contributes to different aspects of the development process, from coding and debugging to database management and testing. This integrated approach ensures that the final accounting system is efficient, reliable, and capable of meeting the needs of the organization. As the demand for more sophisticated accounting solutions grows, the use of such tools will be essential for future developments in this field.

3.7. Initial testing of the system prototype

The initial testing of the AccoSoft system prototype for KASAMNE provided valuable insights that will guide further improvements in functionality and user experience. This phase of development is critical, as it allows researchers to visualize potential outcomes and refine the system based on user feedback. Prototyping engages potential users

during the testing phase and allows developers to gather qualitative and quantitative feedback. This feedback can reveal user preferences, expectations, and pain points, which are invaluable for refining the system. It also encourages an iterative design process. By testing and adjusting based on user interactions, developers can ensure that the final product meets user needs more effectively. In addition, identifying issues early in the development process reduces the risk of costly changes later. This proactive approach can save time and resources, ensuring that the final product is more robust and reliable. Fig. 2 shows the screenshot of the main page of the system and its corresponding menu or system's features.

Fig. 2: Main page of the system

3.8. Technical quality assessment of the mobile testing application made by the IT experts

Table 2 shows the summary of the evaluation made by the IT Experts on the AccoSoft application using the ISO 25010 Software Product Quality Standards tool. The results of the evaluation show that AccoSoft complied with the different software quality criteria of the ISO 25010 Software Product Quality Standards. This indicates that the developed software is a quality software product that can be implemented in KASAMNE Cooperative. These results specify that it has satisfactorily met the product quality standards with minimal or no weaknesses. This is evidenced by the Excellent marks given by the IT experts on the performance of the system in terms of the following criteria: Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability. It is also noteworthy

to mention that among the criteria, Security got the highest mark of 3.60. According to Ramachandran (2015), robust software security requirements help you lock down what your software does so that it can be used only as intended (Ramachandran, 2015).

Table 2: Summary of evaluation results of the AccoSoft assessed by the IT experts

Software product quality categories	Weighted mean	Verbal description
Functional suitability	3.55	Excellent
Performance efficiency	3.46	Excellent
Compatibility	3.56	Excellent
Usability	3.56	Excellent
Reliability	3.42	Excellent
Security	3.60	Excellent
Maintainability	3.30	Excellent
Portability	3.55	Excellent

The technical quality assessment results presented above provide valuable insights that can guide future research and development efforts in the field of accounting software systems. The results above further imply that researchers can explore how emerging technologies, such as artificial intelligence and blockchain, can be integrated into accounting software systems to enhance security, efficiency, and user experience while maintaining high-quality standards. Long-term studies to assess the impact of accounting software systems on organizational performance, financial reporting accuracy, and overall efficiency, providing valuable insights into the real-world benefits of high-quality software are also recommended.

3.9. Assessment of the KASAMNE cooperative personnel on the AccoSoft application

Table 3 shows the summary of the evaluation made by the KASAMNE Cooperative on the AccoSoft application based on the selected criteria from ISO 25010 Software Product Quality Standards.

Table 3: Summary of evaluation results of the AccoSoft as assessed by the KASAMNE cooperative personnel

Software product quality categories	Weighted mean	Verbal description
Functional suitability	3.59	Excellent
Performance efficiency	3.48	Excellent
Compatibility	3.58	Excellent

The KASAMNE cooperative personnel rated the AccoSoft application as "Excellent" across the three evaluated categories: Functional Suitability, Performance Efficiency, and Compatibility. These high scores indicate that the end-users found the system to be: (1) The application effectively meets the cooperative's accounting needs and requirements; (2) The system delivers fast response times and optimizes resource utilization to ensure smooth operations; and (3) The application integrates well with the cooperative's existing systems and processes.

These findings demonstrate that the KASAMNE cooperative personnel are highly satisfied with the AccoSoft application and believe it will be a valuable tool in supporting their accounting practices. The "Excellent" ratings across all evaluated categories suggest that the system has been designed and developed with a strong focus on meeting the end-users' needs and expectations. It is important to note that software requirements are continually evolving, and with this change comes the ongoing need to identify useful characteristics that facilitate measurement and control of the software production process. As the cooperative's needs and the accounting landscape change over time, it will be crucial to periodically re-evaluate the AccoSoft application to ensure it remains aligned with the cooperative's requirements and continues to deliver high-quality performance.

By regularly assessing the application using established quality standards like ISO 25010, the KASAMNE cooperative can proactively identify areas for improvement and make necessary adjustments to maintain the system's effectiveness and user satisfaction in the long run.

The development of an accounting system for KASAMNE faced several coding challenges that are commonly encountered in similar projects. These challenges highlight the complexities of integrating accounting practices with technology. Below are the specific challenges faced by the researchers, supported by relevant literature.

- Integration of Existing Processes: One of the primary challenges was integrating existing manual accounting processes into an automated system. This required a thorough understanding of current workflows to ensure that the new system could replicate or improve upon them. According to NetSuite, managing the transition from manual to automated systems often leads to difficulties in aligning new software with established practices, which can hinder efficiency if not addressed properly.
- User Interface Design: Designing an intuitive user interface that caters to users with varying levels of technical expertise posed significant challenges. The need for accessibility while maintaining advanced functionalities is crucial. Research indicates that user-friendly interfaces are essential for successful system adoption, as they directly impact user satisfaction and efficiency (Bhatta and Hiebl, 2022).

- Data Validation and Integrity: Ensuring data accuracy and integrity during the transition from manual to automated processes was critical. Coding errors can lead to significant issues, such as incorrect financial reporting. As noted in a study on coding skills for accountants, understanding how to implement robust data validation checks is vital for maintaining data integrity and preventing errors during data entry and processing.
- Scalability and Flexibility: The system needed to be scalable to accommodate future growth and changes in accounting practices. This requires careful planning during the coding phase to allow for easy updates and modifications. The ability to adapt to changing business needs is highlighted as a significant factor in the success of accounting systems.
- Security Measures: Implementing adequate security protocols to protect sensitive financial information was another major concern. The integration of security features such as user authentication and data encryption is essential to prevent unauthorized access and data breaches. The importance of security in accounting systems is underscored by the increasing reliance on digital solutions, which makes them vulnerable to cyber threats.

By addressing these challenges, the researchers aimed to create a robust accounting system that enhances efficiency and accuracy in KASAMNE's financial operations. The integration of coding skills with accounting practices is increasingly recognized as essential for modern accountants, emphasizing the need for ongoing education and adaptation in the field.

4. Conclusions

Based on the significant findings of the study, the following conclusions were drawn:

1. Prototype testing played a crucial role in refining the AccoSoft system, allowing researchers to gather user feedback and identify areas for improvement early in the development process. This iterative approach helped ensure that the final product met the cooperative's needs effectively.
2. The technical quality assessment of the AccoSoft system using the ISO 25010 Software Product Quality Standards revealed that the application excels in all evaluated categories, including Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability. This indicates that the system is a high-quality software product ready for implementation.
3. The KASAMNE cooperative personnel's evaluation of the AccoSoft system also yielded excellent results, with the application receiving top marks in Functional Suitability, Performance Efficiency, and Compatibility. These findings demonstrate the end-users' satisfaction with the system and their confidence in its ability to support the cooperative's accounting practices.
4. The development and implementation of the AccoSoft system for KASAMNE Cooperative highlight the potential for technology to streamline accounting processes and enhance efficiency in cooperative organizations.

5. Recommendations

The researchers recommend the following:

1. Conduct regular user training and support sessions to ensure that KASAMNE personnel can fully leverage the AccoSoft system's capabilities and stay up to date with any updates or changes.
2. Establish a system for collecting ongoing user feedback and monitoring system performance, allowing for continuous improvement and adaptation to changing needs.
3. Explore opportunities for integrating the AccoSoft system with other cooperative management tools, such as inventory management or member relationship management systems, to create a more comprehensive solution.
4. Share the development and implementation process of the AccoSoft system with other cooperatives and organizations to promote the adoption of similar accounting software solutions and contribute to the advancement of the cooperative sector.
5. Conduct longitudinal studies to assess the long-term impact of the AccoSoft system on KASAMNE's financial management, decision-making processes, and overall organizational performance.
6. Investigate the potential for adapting the AccoSoft system to meet the accounting needs of other types of organizations, such as small businesses or non-profit entities, to expand its reach and impact.

By implementing these recommendations and building upon the successes of the AccoSoft system development, KASAMNE Cooperative and other researchers can contribute to the ongoing evolution of accounting software solutions tailored to the unique needs of cooperative organizations.

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Compliance with ethical standards

Ethical considerations

Informed consent was obtained from all participants, and data confidentiality was maintained throughout the study.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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