

The Performance Analysis of SainsLab as an Excel-Based Science Laboratory Management Application

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Received: January 23, 2026

Revised: September 29, 2026

Accepted: October 12, 2026

Published: October 31, 2026

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DOI: [10.29303/jppipa.v12i10.14380](https://doi.org/10.29303/jppipa.v12i10.14380)

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Abstract: Science laboratories play a crucial role in enhancing students' knowledge and skills through direct learning experiences. However, many educational institutions in Indonesia still rely on manual, paper-based administrative models, leading to inefficiencies such as inaccurate inventory tracking, equipment damage, and difficulties in monitoring laboratory usage. This study aims to analyze the performance of "SainsLab," an Excel-based laboratory management application designed to transition these workflows into a digital system. Employing a mixed-methods approach with an explanatory sequential design, the study evaluates the application's performance using the IT Balanced Scorecard (IT BSC) framework, which encompasses four perspectives: school contribution, user orientation, operational excellence, and future orientation. The research, conducted with 71 subjects including teachers, laboratory technicians, and students. Based on the IT BSC assessment, the application achieved an overall performance score of 72%, categorizing its performance as good category. Specifically, the application achieved 84% in school contribution, 80% in user orientation, 85% in operational excellence, and 79% in future orientation. The analysis reveals that the application successfully minimizes operational costs, improves the accuracy of inventory data, and provides a highly stable, intuitive interface for users of varying skill levels. The findings indicate that SainsLab effectively supports laboratory management and serves as a strategic, cost-effective tool for digitizing school laboratory operations.

Keywords: Digital administration; IT balanced scorecard; Microsoft Excel; SainsLab; Science laboratory management

Introduction

Science laboratories have an important role in educational institutions because it serves as the main means of improving students' knowledge and skills through direct learning experiences (Hofstein & Kind, 2011; Kind et al., 2011; Rijwani et al., 2025; Psillos & Niedderer, 2002; Tobin, 1990). Science laboratory is a place for scientific research, experiments, measurements, or scientific training conducted in a controlled manner (Ningrum & Rahim, 2025; Nurhadi, 2018; Ernawati & Susanti, 2022). The main function of science laboratories is as a means of verification and

empirical proof that bridges theory and practice, proving abstract concepts, training scientific skills, fostering interest and creativity, and problem-solving abilities (Fitri, 2024; Hastiana et al., 2023; Iswandari & Saputra, 2024; Leite & Dourado, 2013; Lunetta et al., 2013; Malik & Ubaidillah, 2021; Nurhayati, 2022).

Laboratory management involves several aspects, namely planning, arrangement, administration, security, maintenance, and supervision (Ernawati & Susanti, 2022; Astuti, 2020). The purpose of laboratory management includes organized planning of laboratory equipment and material requirements, inventory of laboratory equipment and materials for accurate

How to Cite:

Arfah, N., Khaldun, I., Saminan, S., Rusman, R., Zulfadli, Z., & Zulfira, R. (2026). The Performance Analysis of SainsLab as an Excel-Based Science Laboratory Management Application. *Jurnal Penelitian Pendidikan IPA*, 12(10), 118-127. <https://doi.org/10.29303/jppipa.v12i10.14380>

detection, controlled administrative activities in the laboratory, and management and availability of equipment to achieve optimal laboratory utilization (Astuti, 2020). The other important of science laboratory management is because it can influence the effectiveness of science learning activities (Sulistyanto, 2017), the readiness of science teachers (Chusni et al., 2019), student learning achievement (Wanto & Kusen, 2023), and the quality of practicum implementation (Muhlis et al., 2025; Nugraha & Agustina, 2024).

The transformation of science laboratory management in Indonesia is currently in a transitional phase, during which educational institutions are working to shift from a manual administrative model to a digital management system. Various studies in the field of educational management indicate that although the digitization of school infrastructure has become a national priority, but many school laboratories in Indonesia are still stuck with manual inventory tracking and laboratory procedures due to a lack of digital tools tailored to the needs of laboratory technicians (Nam & Park, 2025). These conditions will reduce the effectiveness of the laboratory sessions, such as equipment not being ready, delays in preparing materials, and equipment malfunctioning just as it is about to be used (Adekunle et al., 2024; Jasmin et al., 2024). As a result, teaching and learning activities are hindered, and learning outcomes are not maximized. Suslistya & Mahadewi (2023) also adds that optimal laboratory management can increase the effectiveness of practical activities.

Preliminary study showed that science laboratory management at SMAN 1 Lhokseumawe and SMAN 2 Lhokseumawe still relies on conventional methods based on manual record-keeping. This reliance on paper-based administration creates challenges inaccuracies in inventory data, difficulties in tracking the history of equipment borrowing and returns in real time, and delays in reporting the condition of laboratory equipment to the school. The others limitations is not only hinder the effectiveness in preparing lab activities on time, but also increase the risk of asset loss, unmonitored equipment damage, and overlaps in logistics. Based on interviews with school officials, other problems with lab management were identified, including a lack of knowledge about the right software, well as the need for software that is affordable and easy to use. Pratiwi & Mulyono (2023) and Dyrberg et al. (2017) emphasize that unstructured practicum management can cause problems and ineffective equipment user.

In today's digital age, the use of computer technology has become a strategic necessity for transforming manual workflows—which are prone to human error—into digital systems that are more precise,

transparent, and measurable period (Sharma et al., 2024; Innocent, 2024; Şişu et al., 2024). This transformation does not always have to begin with the implementation of specialized software that is complex, expensive, and requires a long adaptation. In this context that Microsoft Excel serves as a strategic technological tool, as it possesses significant capabilities to automate workflows, manage data systematically, and streamline manual laboratory administration (Wati et al., 2025; Al Maruf et al., 2022; Balasubramanian, 2024). Another advantage of Microsoft Excel is its cost-effectiveness and ease of operation, unlike specialized management software that requires users to have in-depth technical knowledge, demands complex server infrastructure and a stable internet connection, and is often expensive (Sagi, 2023; Thakurdesai et al., 2024).

Microsoft Excel is a spreadsheet software that serves not only as a mathematical computing tool but also as a highly flexible and adaptable Application Development Environment for school-level laboratory management needs (Bovey, 2009; Bullen et al., 2005; Ye et al., 2025). The use of Excel as the foundation for the SainsLab application is based on its ability to integrate structured data storage, automated processing logic through formulas, and real-time data visualization (Walkenbach, 2013). In the context of science laboratory management, Excel enables the digitization of manual workflows such as equipment inventory, lab scheduling, and the tracking of chemical usage (Moser et al., 2021; Turdaliev et al., 2025). The key advantages of Microsoft Excel in the context of laboratory management applications are design flexibility and customization, cost and infrastructure efficiency, ease of integration, accurate data analysis, and user familiarity (Alexander & Kusleika, 2025; Burnett & Scaffidi, 2014).

The main features of SainsLab include a digitized inventory system, automatic practicum scheduling, equipment condition tracking, and periodic reporting. Based on Microsoft Excel, SainsLab is designed with an intuitive user interface so that it is easy to operate by laboratory personnel of various technical skill levels (Wijaya et al., 2022). Digital management systems are the solution to improve efficiency, accuracy, and transparency in the management of science facilities in schools (Andini et al., 2025; Idzni et al., 2023; Irwandani et al., 2024; Yasir & Idwan, 2024; Shidqi & Tyas, 2024).

The implementation of SainsLab requires performance evaluation to ensure that the application provides tangible added value to schools. According to Laudon & Traver (2020), system performance is assessed based on indicators of operational excellence and cost efficiency, whereby the technology must be capable of minimizing resource usage to produce maximum laboratory report output. In line with this, DeLone & McLean (2003) provide performance indicators through

system quality, information quality, and user satisfaction. These indicators are highly relevant for measuring whether the SainsLab application has assisted teachers and lab technicians in performing administrative tasks. Therefore, a structured assessment can be conducted using the IT Balanced Scorecard (IT BSC) framework to demonstrate that SainsLab has met performance standards.

The IT BSC is a framework developed by Van Grembergen and Van Bruggen in 1997 to measure information technology performance (Triana & Papilaya, 2021). This framework measures application performance through four perspectives, namely: school contribution, user orientation, operational excellence, and future orientation (Triana & Papilaya, 2021). By using this framework, information on the performance of the SainsLab in science laboratory management can be obtained. Therefore, this study aims to analyze performance of SainsLab application as a laboratory management information system.

Method

This study employs a mixed-methods approach with an explanatory sequential design. Methodologically, this design emphasizes the collection and analysis of quantitative data in the first phase, followed by the collection and analysis of qualitative data in the second phase to further explore the initial findings. This phase was selected to provide a comprehensive evaluation of the SainsLab application's performance, in which the results of the questionnaire will be further explained using empirical data collected in the field. The research subjects were selected using a purposive sampling technique, there are 71 people consisting of teachers, laboratory technicians, and students. Data collection in this study was conducted through observation, questionnaires and interviews.

The implementation of the IT BSC framework in this study was comprehensively integrated into the data

analysis process. This integration was achieved through the operationalization of variables, in which the four perspectives of the IT BSC—school contribution, user orientation, operational excellence, and future orientation—were broken down into measurable empirical indicators. Procedurally, this integration serves as a bridge between the quantitative and qualitative phases in an explanatory sequential design. In the quantitative phase, the IT BSC perspectives are incorporated into a questionnaire designed to measure user perceptions of SainsLab's performance; subsequently, in the qualitative phase, this framework serves as a guide for formulating interview questions to explore the underlying information behind the quantitative results.

The questionnaire data collected on a 1–4 Likert scale was converted into percentages to facilitate the interpretation of the SainsLab application's performance level. This conversion was performed using Sugiyono (2018) percentage index formula, by comparing the actual total score obtained to the ideal maximum total score. The resulting percentages were interpreted the performance category for each perspective of the IT Balanced Scorecard.

$$\text{Percentage Value} = \frac{\text{Total Score Actual}}{\text{Ideal Maximum Score}} \times 100\% \quad (1)$$

The Performance Assessment Scale that will be used to interpret the final score is shown in Table 1. The aspects measured of IT BSC perspective are as in Table 2.

Table 1. Interpretation of IT Balanced Scorecard Scores

Interval (%)	Category
85–100	Very Good
70–84.99	Good
55–69.99	Good Enough
45–54.99	Less Good
0.00–44.99	Very Unfavourable

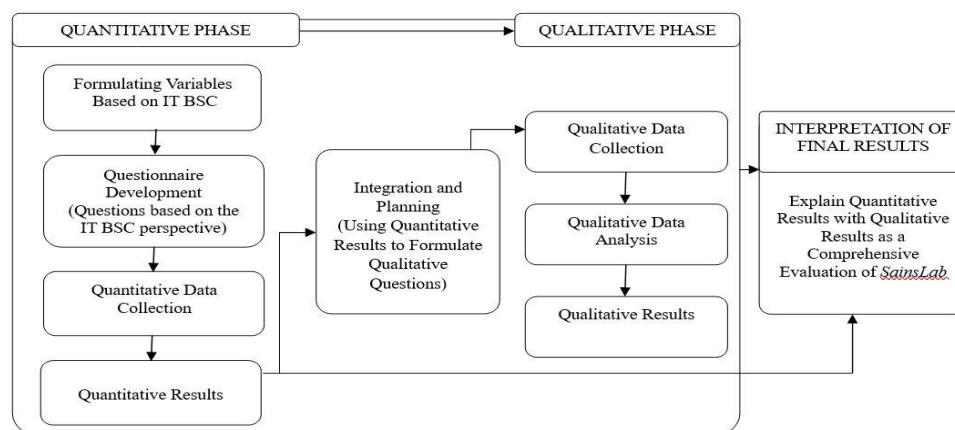


Figure 1. Research stages

Table 2. Aspects of IT BSC

Perspectives of IT BSC		Aspects of Measurement	Respondents
School Contribution	Consistency of SainsLab with the school’s vision and mission		Lab technicians and teachers
User Orientation		The Usability of SainsLab	Students, Lab technicians, and teachers
Operational Excellence		Efficiency of Administrative Tasks	Lab technicians and teachers
Future Orientation		Development and maintenance of SainsLab.	Lab technicians and teachers

Systematic stages of SainsLab application performance analysis through the IT Balanced Scorecard, beginning with the alignment of the school science laboratory management's vision with SainsLab capabilities. The determination of Key Performance Indicator (KPI) weights can be done based on an agreement between the application developer and the school's science laboratory unit, taking into account the priority measurement objectives (Triana & Papilaya, 2021), where the total weight for each perspective is 100%. The stages of SainsLab analysis using the IT balanced scorecard are shown in Figure 2.

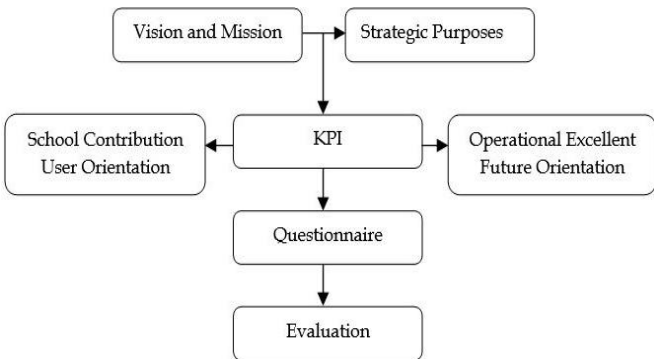


Figure 2. The stages of the IT balanced scorecard evaluation

Result and Discussion

This study aims to measure the performance of the SainsLab application as an Excel-based science laboratory management application. The goal of science laboratory management is to optimize the use of facilities and research to improve the quality of learning. However, the effectiveness of national management laboratories have not been achieved due to the lack of transition from manual to digital as required by educational standards. School reports also identified obstacles such as limited laboratory facilities, a lack of science laboratory technicians, and a management system in schools that still maintains manual records, which can potentially lead to loss and damage of laboratory equipment, making it difficult for schools to monitor the borrowing, maintenance, and return of equipment. These activities will disrupt practical activities in science learning.



Figure 3. SainsLab app

SainsLab is a digital information system in the form of a Microsoft Excel-based application for science laboratory management. This application utilizes the capabilities of Visual Basic for Applications (VBA), Macros, and complex Excel formulas to automate various laboratory administration processes. Its main features include a digitized inventory system, automatic lab scheduling, equipment condition tracking, and lab reporting. The SainsLab application features a main menu, such as laboratory tools, chemicals, laboratory services, and information. Through Microsoft Excel, SainsLab is designed with an intuitive and responsive user interface, making it easy to operate by laboratory personnel of various skill levels. Other advantages are time efficiency, and low implementation costs without requiring server infrastructure. The result analysis of SainsLab as an excel-based science laboratory management application using the IT BSC Framework are shown in Table 3.

The results of the achievement of strategic purposes are shown in Table 4. The performance evaluation of the SainsLab application was conducted by integrating of each KPI into four strategic purposes. Overall, the system demonstrated excellent performance, with the majority of indicators exceeding the 80% target, as shown in Figure 4.

Table 3. Results of KPI

Strategic Purposes	KPI	Target (%)	Actual Conditions (%)	Achievements of KPI (%)
The Perspective of School's Contribution				
Achieving Cost- and Time-Efficient Laboratory Management	Minimizing operational and administrative costs	80	67	83
	Improving the quality of laboratory practice	80	70	87
Total				170
Average				85
The Perspective of User Orientation				
Providing a Satisfying and Solution-Oriented User Experience	Data Entry Guide and Process	80	67	83
	Integration with other systems	80	50	62
	User Satisfaction and Feedback	80	69	86
	Human Resources Support and Data Security	80	66	82
Total				313
Average				78
Perspectives on Operational Excellence				
Ensuring system reliability and the accuracy of laboratory inventory data	Speed, Responsiveness, Stability, and Uptime	80	70	87
	User Interface and User Experience	80	68	85
	Feature completion	80	70	87
	Accuracy of information	80	67	83
Total				342
Average				85
Perspective of Future Orientation				
Ensuring the long-term sustainability and security of the system	App Recommendations	80	60	75
	Application Development	80	68	85
Total				160
Average				80

Table 4. Results of strategic purposes

Strategic Purposes	KPI	Bobot (%)	Achievement of KPI Score (%)	Strategic Purposes Score (%)
The Perspective of School's Contribution				
Achieving Cost- and Time-Efficient Laboratory Management	Minimizing operational and administrative costs	50	83	41
	Improving the quality of laboratory practice	50	87	43
Total				84
The Perspective of User Orientation				
Providing a Satisfying and Solution-Oriented User Experience	Data Entry Guide and Process	25	83	21
	Integration with other systems	25	62	16
	User Satisfaction and Feedback	25	86	22
	Human Resources Support and Data Security	25	82	21
Total				80
Perspectives on Operational Excellence				
Ensuring system reliability and the accuracy of laboratory inventory data	Speed, Responsiveness, Stability, and Uptime	25	87	22
	User Interface and User Experience	25	85	21
	Feature completion	25	87	22
	Accuracy of information	25	83	20
Total				85
Perspective of Future Orientation				
Ensuring the long-term sustainability and security of the system	App Recommendations	50	75	37
	Application Development	50	85	42
Total				79

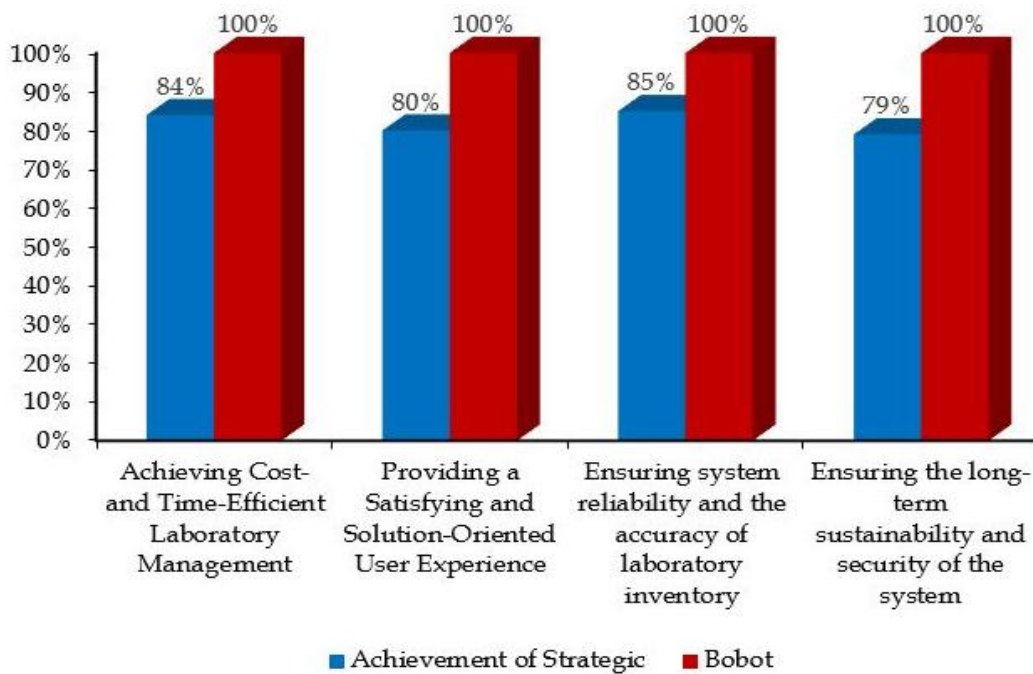


Figure 4. The result of strategic purposes

Achieving Cost and Time-Efficient

This perspective measures the efficiency of laboratory management as reflected in resource savings. The strategy for achieving optimal management scored 84%, with the cost minimization indicator contributing 83% for staff and 86% for students. In line with Laudon's theory, this approach yields efficiency gains in operational expenditures. The digitization of administrative processes has proven effective in significantly reducing paper usage at SMAN 1 and SMAN 2 Lhokseumawe.

Satisfying and Solution-Oriented User Experience

This perspective focuses on end-users' experience and satisfaction with the system's services. The strategic goal of delivering the best possible experience has achieved a score of 80%. User satisfaction indicators reached 86% among staff and 83% among students. These high satisfaction scores align with the DeLone & McLean model, in which system quality drives satisfaction. Users feel that the ease of data entry greatly assists with bureaucratic processes in the laboratory.

Ensuring System Reliability and the Accuracy of Laboratory Inventory Data

This perspective evaluates technical aspects, system reliability, and the accuracy of the information presented. Technical performance in the Stability & Uptime indicators, as well as system speed, achieved an excellent score of 87%. The system's performance is highly reliable in supporting the laboratory's daily operations. However, there is a gap in system

integration, which only achieved a score of 62%. This indicates that while the system is internally very fast and accurate with a score of 83%, synchronization between systems within the school still needs improvement.

Ensuring the Long-Term Sustainability and Security of the System

This perspective measures the sustainability, security, and development potential of the application. The goal of ensuring sustainability achieved a score of 79%, slightly below the target. This is influenced by the application recommendation indicators, which stand at 75% (staff) and 78% (students). Although interest in application development is very high at 85%, the low recommendation score indicates user hesitation if the system is not immediately integrated with other academic systems. On the other hand, data security is already at a safe level with a score of 82%.

The results of the SainsLab application performance measurements, including the total IT BSC scores for each perspective, are shown in Table 5.

Table 5. The total IT BSC scores

Perspective of IT BSC	Bobot (%)	Results (%)
School Contribution	25	20
User Orientation	25	17
Operational Excellence	25	19
Future Orientation	25	16
Total	100	72

This analysis provides a comprehensive assessment of the performance of the SainLab application. The

evaluation takes into account the relative importance of each perspective in achieving the school's strategic purposes. The achievement of the school's strategic objectives reflects the level of efficiency and performance of the SainLab application. The results of the analysis are shown in Figure 5.

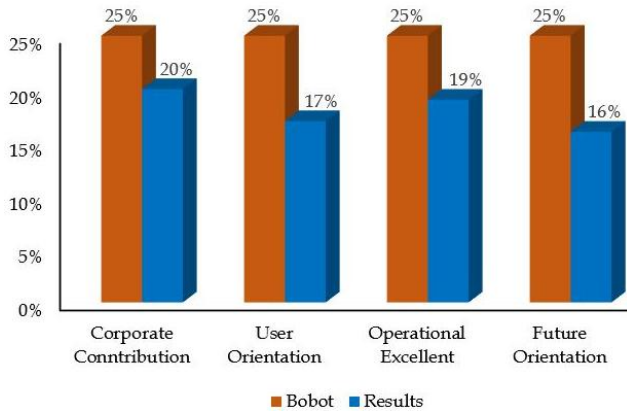


Figure 5. The total IT BSC scores

School contribution perspective with a weight of 25%, a score of 20%, indicates that the application has had a significant impact on laboratory management. This result falls into the good category, indicating that SainsLab has successfully fulfilled its efficiency role in accordance with Laudon's theory. The digitalization efforts have effectively addressed the organization's need to reduce operational costs and manual bureaucracy.

User Orientation Perspective with a weight 25%, a score 17%, indicates that the application is deemed capable of meeting user expectations as a tool to support laboratory practice. In line with the DeLone & McLean model, this achievement demonstrates that the perceived quality of the system is sufficiently mature. This figure indicates that the SainsLab application is user-friendly, thereby enabling the goal of providing a maximum user experience to be achieved.

Operational excellence perspective with a weight 25%, a score 19%, indicates highly stable technical performance. Although it accounts for a smaller portion than the organizational contribution, this result is the primary driver. Without operational reliability at this level, efficiency from an organizational perspective would be impossible to achieve. The accuracy of the data generated by the system serves as a strong foundation for the trust of laboratory staff.

Future-oriented perspective with a weight: 25%, a score 16%, indicates the system is already functionally sound, there is still room for future development. The low weighting assigned to this perspective suggests that schools currently prioritize the application's direct benefits for laboratory tasks. However, this 16% figure

remains crucial as the foundation for system development plans to ensure the application's long-term relevance.

Based on the combined results of these four perspectives, a total score of 72% was obtained. Overall, the performance of the SainsLab application falls into the good category.

Conclusion

The study concludes that the SainsLab application effectively supports laboratory management by digitizing administrative processes and transitioning schools from manual to digital systems. With an overall performance score of 72% based on the IT Balanced Scorecard framework, the application is categorized as good, demonstrating significant improvements in operational efficiency, inventory data accuracy, and user satisfaction. These findings indicate that SainsLab serves as a strategic, cost-effective tool that successfully addresses the challenges of conventional laboratory management.

Acknowledgment

The author team would like to express its appreciation and gratitude to all parties who have been directly and indirectly involved in this research so that it can be completed according to the planned time.

Author Contributions

The lead author, N.A. contributed to designing and conducting the research and writing the article. The second and third author, I.K. and S. contributed in guiding the writing of the article to completion. The fourth and fifth author, R. and Z. contributed to validate the instruments of the article. The sixth author, R.Z. contribute to design the application interface. All authors have approved the version of the manuscript to be published.

Funding

This research did not receive external funding.

Conflicts of Interest

There is no conflict of interest in this research.

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