Journal Applied Computing 8[22]1-8: e50822108
Article

Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops

Implementación de una aplicación móvil para la gestión de tareas y documentación de mantenimiento en talleres automotrices

Sánchez-García, Judith Ruby*[a], Galeana-Victoria, Luis Gustavo[b] and Flores-Azcanio, Nancy Patricia[c]

[a] Universidad Politécnica del Valle de México • LRU-7283-2024 • 0000-0002-5550-5917 • 826268
[b] Universidad Politécnica del Valle de México • LRU-7460-2024 • 0000-0002-6133-1124 • 398137
[c] Universidad Politécnica del Valle de México • LNQ-5488-2024 • 0009-0009-3799-1075 • 673888

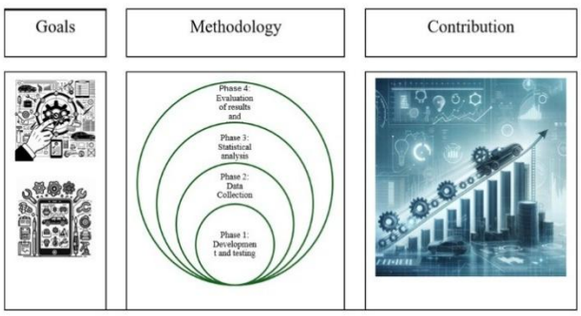
CONAHCYT classification:

Area: Engineering
Field: Engineering
Discipline: System engineer
Subdiscipline: Computer Sciences

https://doi.org/10.35429/JCA.2024.8.22.5.8
Article History:
Received: January 30, 2024
Accepted: December 31, 2024

Abstract

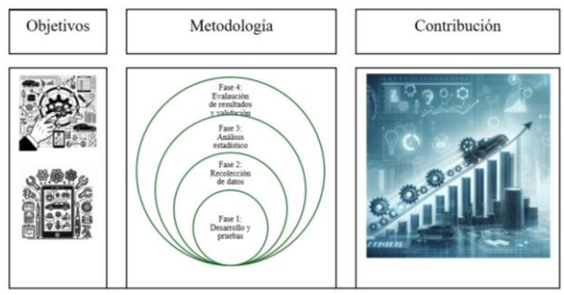
This article presents a detailed report of a study, which evaluates the implementation of a mobile application, designed for the management of maintenance tasks and documentation in an automotive workshop. Developed to drive operational efficiency and employee acceptance of new technologies, the quantitative descriptive methodology included pre- and post-implementation surveys, as well as automatic application usage records. The increase in operational efficiency with a corresponding increase in the accuracy of documentation in the survey results confirms the main assumption. This article provides a clear picture of the impact of using mobile technologies in the workplace.



Application, Efficiency, Implementation

Resumen

Este artículo presenta un informe detallado de un estudio, que evalúa la implementación de una aplicación móvil, diseñada para la gestión de tareas y documentación de mantenimiento en un taller automotriz. Desarrollada con el fin de impulsar la eficiencia operativa y la aceptación de las nuevas tecnologías por parte de los colaboradores, la metodología descriptiva cuantitativa incluyó encuestas previas y posteriores a la implementación, además de registros automáticos de uso de las aplicaciones. El aumento de la eficiencia operativa con el correspondiente aumento en la precisión de la documentación en los resultados de la encuesta confirma la suposición principal. Este artículo ofrece una imagen clara del impacto del uso de las tecnologías móviles en el lugar de trabajo.



Aplicación, Eficiencia, Implementación

Citation: Sánchez-García, Judith Ruby, Galeana-Victoria, Luis Gustavo and Flores-Azcanio, Nancy Patricia. [2024]. Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops. Journal Applied Computing. 8[22]-1-8: e50822108.

Introduction

Dual Education in the state of Mexico has been consolidated as a key strategy to improve students' vocational training (Ignot, 2024). This innovative model combines academic theory with work practice, allowing students to acquire practical skills while continuing their theoretical training in educational institutions (Silvia Cristina Manzur Quiroga et al., 2019). This approach not only strengthens students' skills, but also contributes to the local economy by providing companies with trained and committed personnel (Zavala Sañudo & Huerta Salomón, 2020). Dual Education at the Universidad Politécnica del Valle de México has established itself as an innovative educational strategy that combines theoretical training with professional practice. Through agreements with more than thirty companies and professionals in the country, students have the opportunity to acquire practical skills while continuing their academic training (Rectoria UPVM, 2024). This model allows students to apply the knowledge acquired in the classroom in real work environments, thus improving their employability and preparing them to face the challenges of the labour market. UPVM has implemented several Dual Education programmes that have been well received by both companies and students, who see this experience as a valuable opportunity to develop relevant skills and obtain a comprehensive education.

Having said this, it is now prudent to emphasise that the work described in this document was carried out through this training programme in the Information Technology Engineering degree during the period 2023 - 2024, involving students, teachers and professionals from the company Trev Tek S.A. de C.V.

Effective task management and proper documentation of activities are essential for the success of any automotive workshop. Today, many operators face many challenges due to the lack of digitalisation in their processes, which limits efficiency and service quality (Antonio et al., 2013). With the rapid evolution of mobile technology, a window of opportunity has opened in which applications can be integrated to optimise such processes.

Therefore, this paper aims to present a comprehensive analysis on the implementation of a mobile application focused on the management of maintenance tasks and documentation in automotive workshops. Given the above, it can be stated that not having a digitised system with an intuitive user interface for task management and documentation of maintenance activities in automotive workshops reduces work efficiency and operational quality. (Nuñez-Ovalle, 2022) This extends to the difficulty of organising and tracking processes due to tasks being organised manually and employees' unfamiliarity with digital technologies. This is further complicated when employees are not proficient with advanced technological devices. Therefore, there is a perceived need to implement a digital solution that contributes to these processes by facilitating the efficiency achieved. This defines the following hypothesis as a hypothesis:

By implementing a mobile application in automotive maintenance workshops, it is expected that staff will improve their efficiency in the daily management of tasks and adopt technology more naturally. Furthermore, the application is expected to facilitate accuracy and speed in documenting maintenance activities, thus optimising the work of the team.

Throughout history, automotive workshops have relied on manual process management, resulting in inefficiencies and human error. However, the evolution of mobile technologies has enabled them to be a fundamental resource to optimise this procedure (Khan et al., 2021). Consequently, it has proven to help workshops to be more efficient and accurate in their documentation as well as functions in general. An example of this is the use of mobile applications that are practical for live task management, making it easier to organise and control tasks in an industrial environment. These technologies not only reduce the amount of human errors, but also improve the quality of the service offered by allowing better recording of activities (López et al., 2017). Therefore, the correct management of activities becomes a fundamental pillar for the operational quality of a workshop, obtaining greater performance by better managing resources.

ISSN: 2531-2952
RENIECYT-CONAHCYT: 1702902

Sánchez-García, Judith Ruby, Galeana-Victoria, Luis Gustavo and Flores-Azcanio, Nancy Patricia. [2024]. Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops. Journal Applied Computing. 8[22]-1-8: e50822108.
DOI: https://doi.org/10.35429/JCA.2024.8.22.5.8

On the other hand, Davis' Technology Acceptance Theory showed that ease of use and perceived usefulness are the main factors in the adoption of new technology. Therefore, it can be thought that intuitive interface design would make adoption easy, which, in turn, means that less technologically savvy employees will also be able to get used to the technology (Antonio et al., 2013). Despite clear benefits of mobile application use in the automotive workshop, a main limitation is resistance to change. In scenarios where manual operations were common, such as in the case of automotive workshops, the application of automated tool such as a mobile application in the workshop is considered a factor that has the ability to deter or cause someone to desist from an action or decision (Khan et al., 2021). Therefore, the main constraint that can be faced in the implementation of mobile technology in the car workshop is resistance to change. Constant training is essential to overcome the limitation, as it helps employees to become familiar with the tools and use them properly. Perez's study showed a 20 % increase in labour productivity after the implementation of mobile technology in the shop floor, implying that the use of mobile technology does not violate the workflow, but improves it and also optimises business revenue.

Methodology

This study was based on the descriptive quantitative methodology (Hernández-Sampieri et al., 1991), as the implementation of an application in an automotive workshop is to be evaluated. This approach provided the opportunity to describe how employees perform in terms of application usage, operational efficiency and adaptation to the technology. More specifically, the pre-test and post-test design was used. The results are measured before and after implementation, which helps me to understand how employees' perceptions and practices change after the application is integrated into the work routine. Thirty employees of an automotive workshop were selected as the target population, involving several supervisors and mechanics, with a limit on the age of participants from 20 to 50 years old to ensure an unbiased assessment of different levels of technological knowledge.

Four key phases of the research were then developed. These are: development and pilot testing, data collection, statistical analysis and evaluation of results and validation, which are explained in detail below:

Phase 1. Development and pilot testing

For the development of the application, Scrum was used, an agile implementation methodology to develop and manage software projects in an iterative and incremental way, providing progress through each iteration, which in this is called incremental, obtaining feedback to adapt to changes, scope and optimise the process of delivering value to the customer. This software development methodology was used because it required an application with a simple and intuitive user interface that allows for pilot testing while helping workers to monitor their tasks, record their progress and take images of vehicle maintenance in real time. The technology that supported the application was a REST API, which enabled effective and remote communication of the MySQL database to store task records and images, for the pilot tests were with a limited number of employees to adapt the interface and ensure that the functions were available to people without experience with mobile devices, passing this phase the implementation was applied in the workshop for three months.

Phase 2. Data Collection

Data collection was divided into two stages: pre-implementation and post-implementation. In both tests, participants answered structured surveys with statements constructed on a Likert scale. The pre-test assesses initial perceptions of the technology and task management efficiency. The variables evaluated in the tests were the level of familiarity with the technology, perception of operational efficiency and perception of existing work processes. This method allowed a baseline of employee opinions to be established prior to implementing the application. Subsequently, data is collected for the post-implementation usage monitoring test, in which the workshop implements the application. Quantitative information such as frequency of image capture, time spent on the task and number of images captured was collected to document maintenance activity.

ISSN: 2531-2952
RENIECYT-CONAHCYT: 1702902

Sánchez-García, Judith Ruby, Galeana-Victoria, Luis Gustavo and Flores-Azcanio, Nancy Patricia. [2024]. Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops. Journal Applied Computing. 8[22]-1-8: e50822108.
DOI: https://doi.org/10.35429/JCA.2024.8.22.5.8

Data from this phase was compiled by collecting post-implementation surveys, based on the same Likert test. Table 1 is shown below. Pre- and post-test matching, as well as the name of the variables entered into the spss program.

Box 1

Table 1

Table 1 pre-and post-test pairings

Pre test	Post test	Name of variables	Pairing between the two variables
How familiar do you feel with the use of digital technologies (such as mobile applications) in your daily work?	How often do you use the mobile application to manage your daily tasks in the workshop?	Technology familiarisation Frequency of app use	
How would you rate your current level of efficiency in managing daily tasks in the workshop?	How would you rate your efficiency in task management after the implementation of the mobile application?	Efficiency of work without an app Work efficiency with app	operational efficiency
How efficient do you consider the current process of documenting maintenance activities?	How often do you use the mobile application to capture and store images of maintenance activities?	Documentation without app	accuracy of documentation
How useful do you think the mobile application will be in improving task management and documentation in the workshop?	How satisfied are you with the use of the mobile application in your daily work?	Expectations of the app App satisfaction	
Do you think the mobile application will improve internal communication between employees and supervisors?	How has internal communication between employees and supervisors improved since you started using the mobile application?	Experience of working without an app Work experience with app	technology acceptance

Source: Own elaboration

Phase 3. Statistical Analysis

In this study, we first applied the Kolmogorov-Smirnov test to determine whether or not the data collected follow a normal distribution, and found that they do not because the p-values are very low, less than 0.05 due to the number of participants. Next, table 2 is presented which corresponds to the matching of Employee Technological Adaptation.

In this study, we first applied the Kolmogorov-Smirnov test to determine whether or not the data collected follow a normal distribution, and found that they do not because the p-values are very low, less than 0.05 due to the number of participants. Table 2, which corresponds to the matching of Employee Technological Adaptation, is presented below.

Box 2

Table 2

Matching employee technology adaptation with kolmogorov-smirnov test

	Technology familiarisation	Frequency of use of the app
Test statistic	.241	.266
Sig. salted. (bilateral) p	<.001	<.001

Source: Own elaboration

This table shows how the p-value or sig. asin (bilateral) is less than 0.05 and this is repeated for the following pairings, which led to the conclusion that the statistical analysis should be with the Kruskal-Wallis test for related samples in order to compare the data collected before and after the implementation of the mobile application and to determine the impact of the software. In doing so, differences were calculated between the mean variables evaluated, such as task operation efficiency, frequency of application use and maintenance documentation. Of course, pre- and post-implementation surveys based on a Likert scale provided assessments of how staff perceptions changed before and after the use of the mobile application. By comparing means of pre and post responses with Kruskal-Wallis for related samples, it was possible to determine whether the observed differences were mathematically significant. Below are tables of the combination of variables before and after implementation.

ISSN: 2531-2952
RENIECYT-CONAHCYT: 1702902

Sánchez-García, Judith Ruby, Galeana-Victoria, Luis Gustavo and Flores-Azcanio, Nancy Patricia. [2024]. Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops. Journal Applied Computing. 8[22]-1-8: e50822108.
DOI: https://doi.org/10.35429/JCA.2024.8.22.5.8

The results in table 3, Technology familiarisation test before app, show that, overall, there are no significant differences in technology familiarisation on the variables of app usage. However, for work experience with the app, it is observed that p ≈ 0.087, suggesting a trend towards significance and marginal impact. However, it is recommended to keep the app running and evaluating it.

Box 3

Table 3

Pre-app technology familiarisation test statistics

	Documentation with app	App satisfaction	Experience of working with the app	Efficiency of working with apps	Frequency of use of the app
H de Kruskal-Wallis	2.412	2.478	7.796	4.303	7.235
Sig. asin. o p	.661	.649	.099	.367	.124

Source: Own elaboration

On the other hand, see table 4. Operational efficiency test before app, it can be seen that there is no statistical difference between the operational efficiency without app and the app usage variables, with significance values greater than 0.05 in all cases. This implies that pre-app operating efficiency does not have a significant impact on the use and experience of the app. It can be concluded that the app remains operational and under evaluation.

Box 4

Table 4

Operational efficiency test statistics prior to app

	Documentation with app	App satisfaction	Experience of working with the app	Efficiency of working with apps	Frequency of app use
H de Kruskal-Wallis	3.789	2.214	6.267	1.660	4.089
Sig. asin.	.435	.697	.180	.798	.394

Source: Own elaboration

Table 5 Accuracy test in documentation. The results show that there are no statistically significant differences between documentation accuracy without the app and the app usage variables, with p-values 0.05, except for satisfaction with a slightly peculiar trend, p ≈ 0.051 indicating a possible effect; therefore, it is recommended that the app be maintained and evaluated in the future.

Box 5

Table 5

Accuracy test statistics in documentation

	Documentation with app	App satisfaction	Experience of working with the app	Efficiency of working with apps	Frequency of app use
H de Kruskal-Wallis	2.455	8.888	5.395	2.212	6.765
Sig. asin.	.653	.064	.249	.697	.149

Source: Own elaboration

Table 6 App Expectations Test, However, the rest of the variables present metrics whose p-values exceed the 0.05 mark. The only exception is the variable "satisfaction" reasonably close to the mentioned mark p ≈ 0.081. Therefore, a constant implementation and evaluation of the app seems necessary.

Box 6

Table 6

App Expectations test statistics

	Documentation with app	App satisfaction	Experience of working with the app	Efficiency of working with apps	Frequency of app use
H de Kruskal-Wallis	1.962	8.007	1.479	4.106	5.123
Sig. asin.	.743	.091	.830	.392	.275

Source: Own elaboration

Table 7 Test of work experience without app. The Test of work experience without app yields results that do not differ statistically between the work experience self without app self and the app usage variables; in fact, the p-values are greater than 0.05. However, the variable work experience with the app is significant (p=0.010), which confirms a relevant impact in this area from the implementation of the app. In this sense, it would be relevant to keep the app running and be evaluated.

Box 7

Table 7

Work experience test statistics without app

	Documentation with app	App satisfaction	Experience of working with the app	Efficiency of working with apps	a_pos
H de Kruskal-Wallis	2.918	3.974	11.714	.497	3.006
Sig. asin.	.572	.409	.020	.974	.557

Source: Own elaboration

ISSN: 2531-2952
RENIECYT-CONAHCYT: 1702902

Sánchez-García, Judith Ruby, Galeana-Victoria, Luis Gustavo and Flores-Azcanio, Nancy Patricia. [2024]. Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops. Journal Applied Computing. 8[22]-1-8: e50822108.
DOI: https://doi.org/10.35429/JCA.2024.8.22.5.8

Results

For the validation of the results, one should remember the hypothesis that states: By implementing a mobile application in automotive maintenance workshops, it is expected that the staff will improve their efficiency in the daily management of tasks and adopt technology more naturally. Furthermore, the application is expected to facilitate accuracy and speed in documenting maintenance activities, thus optimising the work of the team. With this in mind, the results obtained (reflected in tables 3, 4, 5, 6, and 7 of Phase 3) will be reviewed to validate the impact of the application on the stated objectives.

In terms of operational efficiency, the results showed no statistically significant differences before and after the implementation of the application ($H = 1.660$, $gl = 4$, $p = 0.798$). Although there was an increase in the mean efficiency from 3.06 to 3.93, this change was not enough to be considered significant. This indicates that the implementation of the app did not have a statistically conclusive effect on improving operational efficiency, suggesting that the use of the app, in terms of direct impact on productivity, may require more time or additional support to consolidate its benefits.

Regarding technology familiarisation, the analysis yielded an H-value of 4.089 with $p = 0.394$, indicating that, although employees perceived an improvement in their familiarity with technology, this was not uniform or consistent across employees. This suggests that the level of prior experience with the technology among staff influences the rate of adoption of the app, which is a relevant aspect for future training programmes.

On the aspect of documentation accuracy, the p-value obtained was 0.653, indicating that there was no significant difference in the pre- and post-implementation accuracy ranges. Although the mean for this variable increased from 3.13 to 3.77, the improvement was not statistically significant, suggesting that the adoption of the app may require more time or improvements in specific functionalities to facilitate and standardise documentation.

Finally, the variables related to technology acceptance and user experience yielded interesting results. The test showed that expectations of improvement were significantly different after implementation, particularly in the comparison of the work experience without the app versus the experience with the app ($H = 11.714$, $p = 0.020$). This indicates that the app's intuitive interface exceeded initial expectations, significantly improving staff perception and willingness to use the technology. Although average satisfaction increased (from 3.26 to 3.83), this increase did not reach statistical significance ($H = 8.007$, $p = 0.091$), indicating that, although perceived as positive, satisfaction with the app varies among users.

Thus, the results suggest that, although operational efficiency and documentation accuracy did not show significant improvements, user experience with the app interface had a significant impact on staff perceptions. This underlines the importance of an intuitive interface in technology adoption, especially in less digitally familiar teams, highlighting the value of user experience in the implementation of new technologies.

Conclusions

In conclusion, in its current state, the app does not have a noticeable immediate effect on efficiency and accuracy. However, the potential of the development is clear when evaluated over a longer period of time. It can be seen that the staff accepts the technology, but with relative calm, the software can become a valuable tool to improve task and document management in the near future.

To ensure the success of the app in efficiency and accuracy over time, it is recommended: 1. continuous training, offering introductory and advanced training so that employees not only start using the app regularly, but also use the advanced features more effectively. 2. feature updates. Implement first-time use feedback to improve features. Include task log automation and document customisation options in future versions of the app. 3. Long-term monitoring. Continue to monitor the application after its second release for further feedback. Analyse whether continued use of the main outcome app systematises efficiency and accuracy in the future. 4. Periodic re-evaluation.

ISSN: 2531-2952
RENIECYT-CONAHCYT: 1702902

Sánchez-García, Judith Ruby, Galeana-Victoria, Luis Gustavo and Flores-Azcanio, Nancy Patricia. [2024]. Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops. Journal Applied Computing. 8[22]-1-8: e50822108.
DOI: https://doi.org/10.35429/JCA.2024.8.22.5.8

Re-evaluate the product after continued use and make any necessary changes to the strategy. This strategy will help develop sustainable successes.

Statements

Conflict of Interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this paper.

Authors' contribution

Sanchez-Garcia, Judith Ruby: responsible for the analysis of the data obtained during the review process. She implemented non-parametric tests such as Kruskal-Wallis to evaluate the efficiency of an approach in the implementation of the mobile application and collection of feedback from participants to achieve greater usability of a user-friendly application.

Galeana-Victoria, Luis Gustavo: participated in the project concept, software design architecture, leading the development phase and pilot testing, with dual education students.

Flores-Azcanio, Nancy Patricia. Contribute to user experience and pilot testing.

Availability of data and materials

Available at:

Pre-test data collection form

Post-test data collection form

Pre-test response

Post-test response

Funding

This project received funding from the PRODEP stimulus through the call for PRODEP 2024 support for PTC with a desirable profile from the universities of the technological subsystem. IDPTC156269.

Acknowledgements

We would like to thank the Universidad Politécnica del Valle de México, as this project was developed as part of the dual education programme offered by this university. To the company Trev Tek S.A. de C.V. that has an agreement with the UPVM and has approximately thirty dual students. To the dual student MELGAREJO RAMÍREZ JORGE LUIS, for his collaboration in the development of this app.

Abbreviations

UPVM	Universidad Politécnica del Valle de México

References

Background

Antonio, O., Díaz, C., Anthony, R., De, D., Edwin, P., & Medrano, A. P. (2013). “Sistema De Gestión De Mantenimiento Productivo Total Para Talleres Automotrices Del Sector Público.” Repositorio Institucional de La Universidad de El Salvador.

Hernández-Sampieri, R., Fernández-Collado, C., & Baptista-Lucio, P. (1991). Metodología de la Investigación (Mac Graw Hill Company, Ed.; Quinta). Mc Graw Hill.

López, F., Secaira, G., & Utreras, G. (2017). Estudio del Mejoramiento de la Productividad aplicando un sistema de Administración de Talleres Automotrices. In Universidad Internacional del Ecuador.

Basics

Kolmogorov–Smirnov Test. (2008). In The Concise Encyclopedia of Statistics.

Hanssen, G. K., Stålhane, T., & Myklebust, T. (2018). SafeScrum® – Agile Development of Safety-Critical Software. In SafeScrum.

Support

Khan, R., Taqi, M., & Saba, A. (2021). The role of digitization in automotive industry: The Indian perspective. International Journal of Business Ecosystem & Strategy (2687-2293), 3(4).

ISSN: 2531-2952
RENIECYT-CONAHCYT: 1702902

Sánchez-García, Judith Ruby, Galeana-Victoria, Luis Gustavo and Flores-Azcanio, Nancy Patricia. [2024]. Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops. Journal Applied Computing. 8[22]-1-8: e50822108.
DOI: https://doi.org/10.35429/JCA.2024.8.22.5.8

Zavala Sañudo, C. G., & Huerta Salomón, M. (2020). El rediseño curricular y la transición de la educación tradicional a una educación dual. TRASCENDER, CONTABILIDAD Y GESTIÓN, pag. 15.

Differences

Nuñez-Ovalle, B. (2022). Diseño e implementación de un sistema integrado de gestión para un taller automotriz

Discussions

Silvia Cristina Manzur Quiroga, Miguel Martínez López, & Agustín Cortés Rebolledo. (2019). El sistema de educación dual en México: caso universidad politécnica del valle de Toluca. Dilemas Contemporáneos: Educación, Política y Valores.

Ignot, J. (2024, July 7). Gobierno del Estado de México fortalece el modelo de Educación Dual.

Rectoría UPVM. (2024). Convenios | Universidad Politécnica del Valle de México.

ISSN: 2531-2952
RENIECYT-CONAHCYT: 1702902

Sánchez-García, Judith Ruby, Galeana-Victoria, Luis Gustavo and Flores-Azcanio, Nancy Patricia. [2024]. Implementation of a mobile application for the management of maintenance tasks and documentation in automotive workshops. Journal Applied Computing. 8[22]-1-8: e50822108.
DOI: https://doi.org/10.35429/JCA.2024.8.22.5.8