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Digital Curation of National Heritage: Usability Testing and Usefulness Survey on an Online Artefact Management from Johor Sultanate Era

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Abstract

Conservation and preservation of cultural heritage artefact offer resources for research studies, teaching and learning as well as tourism awareness. Manual documentation of artefacts results to issues of conserving, tracking, and managing the artefacts in collection. The objective of this study is to digitally curate and manage Johor History Gallery artefact documentation and loan from Johor Sultanate before the independence era. The developed system is tested with five subject matter experts through observational usability testing to measure the task completion correctness. In addition, USE questionnaire is used to assess the system usefulness, satisfaction, ease of learning and ease of use. The results indicate that the system is highly effective and well-received. The USE survey data showed widespread approval across critical metrics, with users affirming the system significantly enhances their work or daily activities. The user-friendly interface, characterized by well-organized buttons, clear labels, and intuitive design elements, facilitated effortless navigation and usability. In summary, the digital curation and management system for the Johor History Gallery significantly improves the conservation, tracking, and management of artefacts.

1. Introduction

A museum is an institution that preserve and exhibit collection of items such as cultural heritage, artwork and scientific and technological discoveries for public access [1], [2]. A gallery, on the other hand, is a casual setting where anybody may purchase the exhibited collection. More like modern showrooms, galleries may represent certain artists or specialise in particular genres of art [3]. Galleries prioritise particularly on attraction and sales whereas museums concentrate on education and preservation. Johor History Gallery (JHG) exhibits collection of historical heritage across Johor sultanate eras particularly artefact from before the independence era. Strategic location of the gallery situated in between train station and hotels in the capital city of Johor, which also near to the border of Singapore makes it as one of the centre attractions for tourist from and / to Singapore in the city. Historical artefacts symbolise common history which should be conserved. Access to these objects, many of which are valuable, facilitate research, teaching and learning through exploration on a variety of aspects of Johor's past.

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1.1 National Heritage Act 2005 (Act 645)

Malaysian Government has enacted The National Heritage Act 2005 (Act 645) which promulgated that national heritage, natural heritage, tangible and intangible cultural heritage, underwater cultural heritage, treasure trove should be conserved and preserved for related matters. On the other hand, the NHA defines treasure troves as currency found hidden in or affixed to soil where honour with unknown and cannot be found but does not include any tangible cultural heritage. Meanwhile, relics are defined as archaeological deposit aged more than 50 years old. Artefact refers to manmade object of cultural or historical interest. NHA also define the term collector as any person who acquires tangible movable cultural heritage for purposes other than sale. The Johor History Gallery is owned by a personal collector of artefacts such as the Kangchu system artefact, tramway, Johor first train key set 1924, and vintage cameras.

1.2 Reign of Johor Sultanate Era

The National Heritage Act 2005 (NHA) defines antiquities as movable object which is reasonably believed to be at least 50 years old or remain of living things believed to be at least 100 years old. Based on this definition, this study focuses on artefacts of the first two Johor Sultanate reign particularly His Highness (H.H) Sultan Sir Abu Bakar Ibni Daeng Ibrahim and H.H Sultan Sir Ibrahim Ibni Sultan Abu Bakar of Johor who ruled during pre-independence era.

H.H Sultan Sir Abu Bakar Ibni Daeng Ibrahim, often referred to as the "Father of Modern Johor," ruled for 30 years from 1862 to 1895 [4]. He played a crucial role in modernizing Johor by setting up a structured government, promoting agricultural development, and enhancing infrastructure. His reign saw significant progress, including the establishment of Johor Bahru as the administrative capital and the introduction of modern institutions and amenities.

H.H Sultan Sir Ibrahim Ibni Sultan Abu Bakar, successor of H.H Sultan Sir Abu Bakar Ibni Daeng Ibrahim ruled for 64 years from 1895 to 1959, continued his father's modernization initiatives. His extensive reign witnessed further infrastructure development, such as the construction of roads, railways, and public buildings. Sultan Ibrahim was known for his strong ties with the British colonial administration, which significantly influenced Johor's development during the late colonial period.

Artefacts from these periods, including documents, tools, coins, and personal items, offer valuable insights into the socio-political and economic changes in Johor during the late 19th and early 20th centuries. These objects reflect not only the personal histories of the sultans but also the broader historical context of Johor's evolution from a traditional sultanate to a modern state under British influence.

By examining these artefacts, the study aims to illuminate Johor's cultural and historical heritage, providing a deeper understanding of its legacy and the pivotal roles of H.H Sultan Sir Abu Bakar and H.H Sultan Sir Ibrahim in its development. This focus on pre-independence artefacts aligns with the NHA's definition of antiquities, highlighting the historical importance of objects that are at least 50 years old.

1.3 Digital Preservation and Digital Curation

Curator a heritage profession which involves collecting, preserving and understanding history of exhibited object (curation) [5], [6], [7]. Nevertheless, the emergence of digital era has expanded the role of curator to engaging interaction to collected items and introducing digitalisation effort in preserving historical evidence for access over time [6], [7]. Digital curation is the process of collection, selection, organisation, and dissemination of digital information including text, images and videos [7]. This benefit lesser risk of damage by physical handling of artefact and promote wider audience such as international institutions to the collection access.

The Johor History Gallery collects an extensive number of artefacts across the period of the Sultanate of Johor such as swords, daggers, and battle weapons, as well as ancient photographs of royal Johor family. The artefacts are sourced from donations from the public, purchase from antique shops, and discoveries made by gallery's expedition teams through exploration on sites including woods, and riverbanks in Johor. History of the artefact are indirectly identified through video recording of verbal heritage description during discovery or manually documented once the artefact arrives in the gallery for exhibition. However, the gallery team often fails to document crucial details of the artefact when they are excited upon its discovery. As a result, precise information on the historical significance, source and periods of certain artefact discovery are incomplete. The gallery struggles with this manual approach due to absence of computerised platform for digitally curating the artefact.

In addition, the Johor History Gallery struggles with the issues of conserving, tracking, and managing the historical items in their collection. There are occasions on where the artefacts are requested for loan from government bodies such as National Archives of Malaysia and universities for exhibitions and research studies. Nevertheless, due to the inefficient artefact managements, loan requests for the artefact were never recorded. Consequently, certain artefact is sometimes lost as it was never returned to the gallery and the loan was not documented.

Hence, there is a critical need for effective curation and management on the artefact inventory. Nevertheless, the gallery has no computerised system, IT literacy skills and computer devices. Therefore, an artefact management system for the gallery should be designed with learnability, ease of use and usefulness to accommodate non-IT personnel particularly the gallery team in operating and utilising the system without extensive technical training.

This study aims to protect the nation's cultural legacy through an online information system for managing the Johor History Gallery's artefacts. In this paper, the authors attempt to digitally curate and manage the artefact registry and loan for the Johor History Gallery. Finally, this paper conducts usability testing and usefulness evaluation on the Online Artefact Management for Johor Sultanate Era.

The following sections explains the material and methods used in developing and evaluating the delivered solution. Section 3 presents and discusses the usefulness evaluation result. Finally, the concluding remark is summarised in the last section.

2. Material and Method

PIKAS is developed using the Waterfall Methodology. This methodology involves the collection of data necessary in designing PIKAS artefact curation and verification features which includes the Requirements phase, Design phase, Coding phase, Testing phase and Operations phase [8].

2.1 Requirements Phase

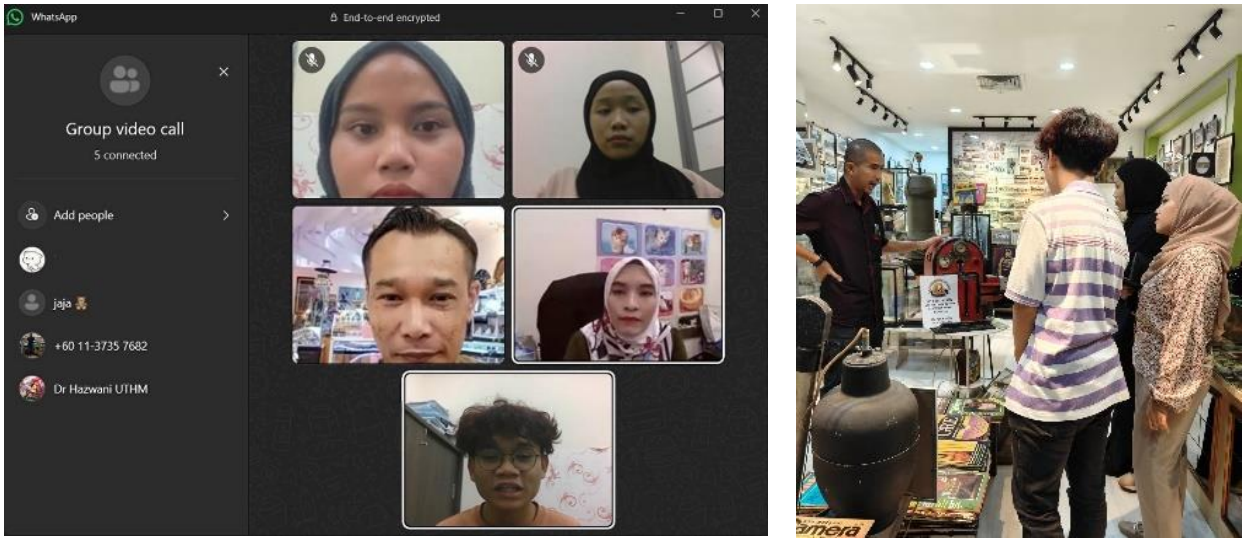
Unstructured interview was conducted through WhatsApp video call to gather the PIKAS requirements. The interview was established through online video call rather than other online meeting platform due to the lack of technology literacy of the gallery team.

Table 1 *Interview questions*

Operational Profile	Artefact Documentation
1. How many employees manage this gallery?	10. What is the origin of the artefact collection?
2. What are the tasks of each employee?	11. What type of artefact collections are present?
3. What are the daily activities in operating this gallery?	12. Is the artefact collection in this gallery involved with external exhibitions?
4. Who are the gallery artefact search team?	13. What is the procedure for checking in and out artefacts within the gallery?
5. What is the role of each artefact search team member?	14. What information is recorded regarding the artefact collection?
	15. What constitutes the primary collection of the artefact within the gallery?
Business Process	16. What criteria are used to categorize artefact collections in gallery exhibitions?
6. How is gallery inventory management done?	17. Which eras are used to categorize artefacts?
7. What are the problems encountered in managing artefact collection information?	18. Is it straightforward to learn how to utilised the system?
8. Does the Johor History Gallery still use paper-based system in recording information on the artefact collection?	19. What method is used to record data when discovering artefacts in the forest?
9. How do you track borrowed artefact?	20. Where are the artefacts that are not on display stored?

Table 1 presents the entire interview questions. The gallery representative, Mr. Mohd Fariz Johari was asked series of established questions such as operational profile, artefact documentation process and business process of the Johor history gallery to understand how the artefacts are managed and documented in the gallery. Additional questions were asked depending on the participant response to gather more detailed information on the gallery business process for business automation.

The interview session is followed by a physical visit to the gallery to capture information on artefact description was established through representative of Johor History Association, Mr. Mohd Azlan Mohd Shariff. Photos and details of artefacts from Johor Sultanate era was documented during the visit. Fig. 1 presents the activities conducted in the analysis phase.



(a) **(b)**

Fig. 1 *Analysis phase activities (a) Online interview; (b) Data collection*

2.1.1 Artefact Curation

Artefacts in the Johor History Gallery are digitally curated in PIKAS. This study integrates the curation technique implemented by the artefact repository centre of Johor Heritage Foundation and the National Museum.

Table 2 *Digital Curation Technique for Johor Artefact*

Artefact	Curation		Johor Sultanate Period
Relic Antique Treasure troves	FG (Fotografi) *Photography* KM (Kamera) *Camera* MS (Manuskrip) *Manuscript* KC (Kangchu) *Kangchu* LK (Laluan Keretapi) *Train Line* KK (Kunci Keretapi) *Train Lock* CH (Cenderahati) *Sourvenir* BN (Batu Nisan) *Tombstone* BS (Batu Sempadan) *Border Stone* SM (Seramik) *Ceramics*	PP (Peralatan Perang) *War Equipment* PB (Patung Batu) *Stone Doll* AM (Alat Muzik) *Musical Instrument* SJ (Senjata) *Weapons* BS (Basikal) *Bicycle* ST (Setem) *Stamp* MW (Mata Wang) *Currency* FS (Fosil) *Fossils* MG (Mesin Getah) *Rubber Machine*	Sultan Abu Bakar ibni Daeng Ibrahim Sultan Ibrahim ibni Sultan Abu Bakar Sultan Ismail ibni Sultan Ibrahim Sultan Iskandar ibni Almarhum Sultan Ismail Sultan Ibrahim Ismail ibni Almarhum Sultan Iskandar

Table 2 presents the curation of artefacts for Johor history gallery. Each artefact is curated by the artefact type for fast identification. The artefacts are further curated into specific period of Johor Sultanate reign, similar to Malaysia Nationale Museum curation technique which organises their digital exhibition by historical period.

2.2 Design Phase

PIKAS user interface mock-up design was sketched using Pencil software to illustrate a clear view of PIKAS look and feel. The user interface for data entry was designed according to Miller's Law. Each form for the data manipulation is designed with less than seven (plus or minus two) call to action such as button and icon to enforce user's memorability. Law of proximity was also enforced in designing PIKAS information architecture by grouping similar items under the same collapsible sidebar menu. In designing the aesthetic look, consistent and logically related colour theme is employed for both the artefact management and verification module.

The system flow and automated business processes are visualised through a Data Flow Diagram (DFD). Meanwhile, database relationships are visualised using Entity Relationship Diagrams (ERD). Using the client-server architecture, PHP are the main language adopted to code PIKAS on the server side for handling request and interacting with the database. The client side is coded by JSON and JavaScript beside HTML and CSS. Fig. 2 presents PIKAS system flow.

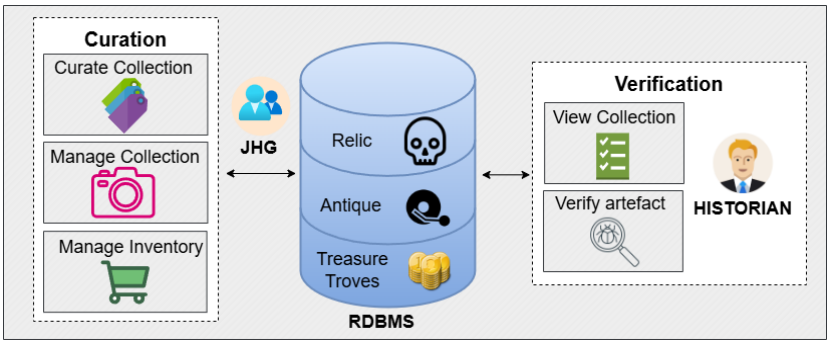
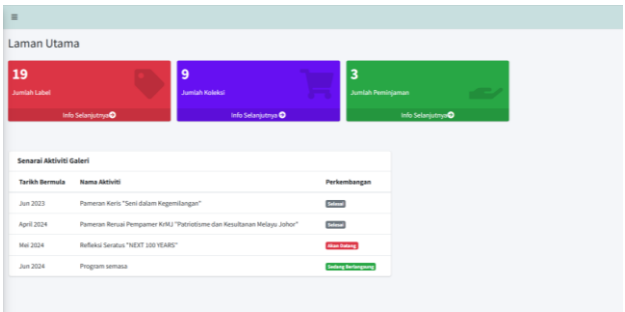


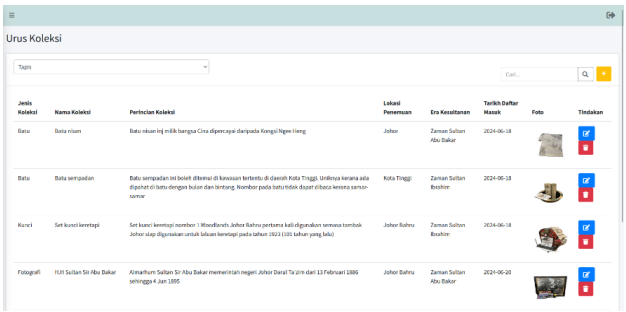
Fig. 2 *PIKAS system flow*

2.3 Coding Phase

The system development adopted AdminLTE bootstrap template for the system design. Functionalities of PIKAS was later coded using Brackets integrated development environment (IDE). The integration of PIKAS functionalities and the artefact's MySQL database in MariaDB is connected using Apache web server in XAMPP web server package. Unit testing was performed upon completion of each feature to ensure PIKAS is able to curate and record artefact information and loan activities. Connectivity between each feature is then tested by performing integration testing to ensure curated and recorded artefact are available for loan and returned artefact immediately available for loan. Fig. 3 presents the user interface for curating and recording artefacts in the Johor History Gallery, and the artefact verification features for historian access.



(a)



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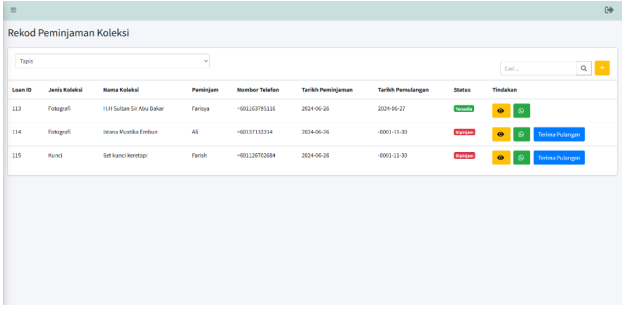

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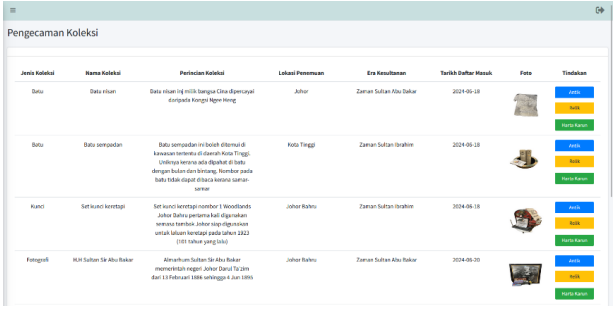

(d)

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Fig. 3 *PIKAS user interface (a) Dashboard for Gallery Team; (b) JHG Collection List; (c) JHG Artefact Inventory Management; (d) Item Verification by Historians*

The gallery management team can record details on newly discovered artefact and curate the artefacts under predefined curation or newly added curation. The gallery team can also record loan and returned of artefact from the gallery to institutions, therefore trace the availability of gallery artefact. Appointed historian on the other hand can verify the validity of recorded artefact.

2.4 Testing Phase

Usability testing is conducted to test the fully functioned PIKAS with the gallery team, Johor History Association representative, and two other subject matter experts. The observation is done through participant's screen recording and video recording. Through the recording, user behaviour and task performance in operating the system are observed. At the end of the session, the participants are required to fill in USE questionnaire [9] to gather feedback on the system usefulness, satisfaction, ease of learning, and ease of use. The questionnaire is distributed using online Google Forms.

2.5 Operation Phase

PIKAS is delivered to the gallery team for their use through live web hosting service. The system is electronically accessible through mobile devices and computer at https://johorhistorygallery1.000webhostapp.com (certain computer might display warning upon access due to firewall setting).

3. Result and Discussion

This section presents the response from usability survey among the Johor History Gallery team and Johor History Association members. The responses are explained in the discussion section.

3.1 Result

The survey findings depicted in Fig.4 underscore a notably favorable reception of the Pengurusan Inventori Koleksi Artifak Sejarah (PIKAS) system among respondents, encompassing members from the Johor History Gallery, a librarian from UTHM, and a historian. Particularly striking are the resoundingly positive responses from the Johor History Gallery team, with prominent blue bars dominating the graphs, indicating strong agreement on the system's significant utility.

The consensus among respondents, especially from the Johor History Gallery, overwhelmingly leans towards affirming the system's high usefulness. This attests to its efficacy in managing and cataloguing historical artifacts, streamlining inventory procedures, and facilitating easy access to critical information.

In terms of ease of use, the most of respondents expressed a "Sangat Setuju" (Strongly Agree) sentiment, implying that the system's interface is intuitive and user-friendly. This suggests that the system's design likely incorporates clear instructions, logical workflows, and responsive features, contributing to its positive perception.

Likewise, the ease of learning aspect indicates that most respondents found the system straightforward to grasp. This is likely due to well-designed training materials, user guides, and a supportive system that aids users in swiftly acquiring proficiency. The widespread agreement in this area suggests that users can quickly gain the necessary skills to operate the system effectively, reducing the learning curve.

However, opinions on the overall impressiveness of the system vary, with a mix of strong agreement, agreement, and a few instances of disagreement. These discrepancies might stem from differences in individual expectations or specific experiences with certain features. Nonetheless, the prevailing sentiment remains overwhelmingly positive, affirming the PIKAS system's commendable practicality, user-friendliness, and overall effectiveness in managing historical artifact inventories.

Fig. 4 displays feedback on the PIKAS system regarding its usefulness, ease of use, ease of learning, and satisfaction.

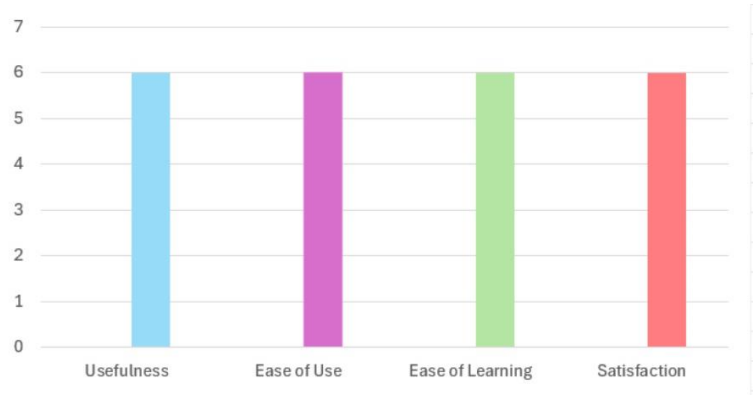

Fig. 4 *USE Survey Response of usefulness, ease of use, ease of learning, and satisfaction*

3.2 Discussion

The result of testing phase show USE survey provided valuable data on how users evaluated the system's usefulness, satisfaction, ease of learning, ease of use. The evaluation findings regarding the PIKAS system indicate widespread approval across critical metrics. Users overwhelmingly attest to PIKAS significantly enhancing their work or daily activities, clearly demonstrating its alignment with user expectations.

Additionally, users commend PIKAS for its user-friendly interface, characterized by well-organised buttons, clear labels, and intuitive design elements that facilitate effortless navigation and usability.

Regarding ease of learning, most users affirm that PIKAS is straightforward to understand and operate, requiring minimal training, guidance, and a short briefing. This underscores the system's intuitive design and efficient user onboarding process.

Overall satisfaction with PIKAS is notably high, with a significant majority expressing satisfaction with its performance and overall user experience. However, feedback suggests areas for potential improvement. Specifically, one user recommended the addition of features or interfaces aimed at enhancing public accessibility or usability, indicating a desire for broader functionality or inclusivity.

Fig. 4 visually represents these evaluation insights, encapsulating PIKAS's positive impact while highlighting opportunities to enhance user satisfaction and maximize system effectiveness.

4. Conclusion

The transition of the Johor History Gallery from a manual to a digital artefact management system, facilitated by the development and implementation of PIKAS, signifies a notable stride in the preservation and documentation of Johor's esteemed cultural heritage. Methodically adhering to the Waterfall Methodology, PIKAS was meticulously crafted to embody user-friendliness, efficiency, and resilience, effectively addressing pivotal requisites such as inventory management, artefact verification, and loan tracking. Rigorous usability testing affirmed that PIKAS substantially augments the organization, oversight, and accessibility of the gallery's expansive collections, rendering it an indispensable resource for both the gallery personnel and esteemed historians. The system's intuitive interface ensures seamless navigation and utilisation, catering even to users with limited proficiency in information technology. By digitizing the curation and documentation processes, PIKAS not only safeguards invaluable historical artefacts but also streamlines their availability for research, educational endeavours, and public engagement, thereby enriching the comprehension and appreciation of Johor's enduring cultural legacy.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Hazwani Rahmat, Muhammad Farish Normesham;* ***data collection:*** *Hazwani Rahmat, Farisya Ilyani Yunus, Nurul Farwizah Abd Shukor, Muhammad Farish Normesham;* ***analysis and interpretation of results:*** *Hazwani Rahmat, Farisya Ilyani Yunus;* ***draft manuscript preparation:*** *Hazwani Rahmat, Farisya Ilyani Yunus, Nurul Farwizah Abd Shukor. All authors reviewed the results and approved the final version of the manuscript.*

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