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A STUDY ON THE MODERN TRANSFORMATION AND DESIGN OF JIESHOU PAINTED POTTERY PATTERNS FROM THE PERSPECTIVE OF SHAPE GRAMMAR

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ABSTRACT

Jieshou painted pottery is a form of folk art from Jieshou City in China. Despite being listed among China's first batch of cultural heritage sites, its inheritance situation is less than optimistic due to a lack of effective promotion. This study explores the application of Jieshou painted pottery patterns in modern cultural and creative products to safeguard the preservation and development of Jieshou pottery culture and to activate pathways for its inheritance. The research combines Shape Grammar (SG) theory with literature analysis, utilizing computer-aided design to delve deeply into the patterns of Jieshou painted pottery. By creating new derivative patterns through the morphological inference of SG and applying them to cultural and creative designs, these derivative patterns enrich the traditional visual expression of Jieshou pottery patterns and broaden avenues for cultural dissemination and promotion. It also substantially advances effective communication and dynamic inheritance of our country's traditional cultural resources within a contemporary context.

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1. Introduction

Jieshou painted pottery, hailing from Jieshou City in Anhui Province, China, is renowned for its distinctive shapes and richly decorated patterns, often referred to as 'a brilliant pearl of ceramic art in the Central Plains.' Originating from the Tang and Song dynasties, this pottery craft reached its zenith during the Ming and Qing dynasties. It has developed a unique regional character and artistic flair in its modern evolution, leading to its inclusion in the first batch of National Intangible Cultural Heritage by the State Council in 2006. In the 1970s, Jieshou painted pottery, which was showcased in over a dozen countries, including Eastern European nations and Japan, earning recognition as a form unparalleled in decorative richness.

As a significant intangible cultural heritage, Jieshou painted pottery boasts a history spanning thousands of years, with its pattern designs carrying profound cultural implications and historical weight. Thus, studying the application of its decorative elements aids in preserving and perpetuating this cultural gem. The pattern arrangements in Jieshou painted pottery typically follow bilateral and quadrilateral symmetry, lending themselves well to the derivation of regular motifs. Shape Grammar (SG) allows for the generation of regular patterns according to the evolutionary rules of basic shapes inputted by designers, and these motifs, imbued with geometric forms and cultural meanings, can be integrated into cultural and creative product designs. Hence, by applying SG theory and using cultural and creative products as a medium, Jieshou painted pottery culture is embedded, aligning seamlessly with contemporary trends.

2. Literature Review

A comprehensive literature review indicates that the application studies of Jieshou painted pottery predominantly revolve around several theoretical dimensions, including cultural ecology, cultural heritage conservation, and iconography. These research perspectives offer a profound analysis of the artistic characteristics and cultural values of Jieshou painted pottery. They also provide diverse theoretical foundations and practical routes for the modern inheritance and innovative development of this invaluable cultural heritage.

Studies conducted from a cultural ecology perspective include:

Gao Feng, (2010) explored the artistic features and production techniques of Jieshou painted pottery. Hu Jiyun (2015) analyzed and summarized the current survival status and challenges faced by Jieshou painted pottery. This study aims to seek new paths for its creative industrialization from a practical perspective.

Jiang Wenmiao (2015) emphasized the idea of balancing ecological preservation with the expansion of craftsmanship. The paper highlights the importance of building the cultural brand of Jieshou painted pottery and developing marketing strategies for derivative products centered around painted pottery.

Studies from an iconographic perspective include:

Fan Huijun (2015) explored the artistry and deep-seated values of the "Sword-wielding Knight" in Jieshou painted pottery and its relationship to traditional Chinese opera.

Gao Feng (2015) interpreted the reasons behind the formation and artistic features of the opera character patterns in Jieshou painted pottery.

Zhao Yanfei (2015) studied the rhythm and melody of lines in Jieshou painted pottery patterns, as well as the relationship between line shaping and craftsmanship in decorative patterns, exploring their unique charm.

Studies from the perspective of intangible cultural heritage protection and development include:

Chen Jing (2015) analyzed the directions, levels, and strategies of product derivation from the perspectives of product design and tourism culture.

Wang Ziduo (2015), from the perspective of intangible cultural heritage protection and resource development, proposed ideas for deepening the inheritance and development of painted pottery.

Wu Congrui (2011) suggested that to help Jiexiu painted pottery overcome difficulties and dependencies, attention should be given to the support and integration of cultural education, seeking industrial development, and enhancing brand awareness.

The application research of Jieshou painted pottery patterns is a multi-disciplinary topic encompassing history, art, design, and cultural preservation and transmission. While notable advancements have been made, significant potential for further exploration exists, especially concerning the utilization of modern technology for digital conservation, the active continuation of cultural traditions, and smart design innovations. Therefore, to effectively perpetuate and evolve its cultural legacy, Jieshou painted pottery's visual culture elements must harness cutting-edge technologies. Moreover, integrating these efforts with commercial strategies is crucial for achieving long-term sustainability and profound impact.

3. Methodology

3.1 Literature Review Method

A systematic categorization and organization of the historical evolution and artistic characteristics of Jieshou painted pottery are conducted through relevant books and online resources. Based on the literature review, related books and documents to the article's theme are consulted, including titles like "Jieshou painted Pottery," "China's painted Pottery," "The Path of painted Pottery," "Chinese painted Pottery Catalog," and "China's Primitive painted Pottery." These materials provide a comprehensive introduction to the development history and artistic style characteristics of painted pottery across different regions in China, serving as a basis for subsequent summaries of Jieshou painted pottery's artistic style and element analysis.

3.2 Field Investigation Method

Conducting a field investigation of the painted pottery art in the Jieshou region aims to gain an in-depth understanding of the craftsmanship involved in creating Jieshou painted pottery. Based on preliminary literature research, extensive exchanges with artisans engaged in Jieshou painted pottery were conducted. By observing their creative processes, gaining firsthand experiences, and further understanding the technical details, an in-depth exploration of the artistic characteristics of Jieshou painted pottery was conducted.

3.3 Case Study Approach

Representative examples of Jieshou painted pottery are selected as subjects for study, utilizing the theory of form grammar alongside professional computer software to precisely extract design elements from Jieshou painted pottery decorations. Through analysis and re-creation, patterns that meet modern esthetic standards are generated and applied to the design of cultural and creative products.

4. Results

4.1 Artistic Characteristics of Jieshou Colored Pottery Decoration

Types and Characteristics of Jieshou Colored Pottery Decoration

The decorative patterns of Jieshou painted pottery are rich in content and diverse in origin. The primary compositional styles include symmetrical patterns, two-way and four-way

continuous pattern layouts, independent unit patterns, and rotational patterns. These patterns can be broadly categorized into plant motifs, animal motifs, and human story motifs.

The decorative techniques of Jieshou painted pottery are unique, employing intricate carving methods. After applying a slip to the pottery body, the surface is carved, revealing a strong color contrast of ochre, yellow, or ochre-white by removing parts of the slip. This ensures the clarity and dimensional richness of the pattern lines, creating an artistic beauty where points, lines, and surfaces are highly integrated. Additionally, Jieshou painted pottery not only inherits the excellent craftsmanship of Tang Dynasty tri-colored ceramics but also ingeniously incorporates the esthetic qualities of traditional Chinese paper-cutting art and woodblock New Year paintings. This results in patterns that retain the ancient and profound traditional style while exuding a strong sense of folk life and vibrant energy.

In terms of color treatment, Jieshou painted pottery skillfully uses various glaze colors to complement each other, producing bright but not overly garish hues. This highlights a visually striking impact similar to Tang tri-colored ceramics and creates a uniquely characteristic glaze charm. Regarding the expression of lines, the artistry highlights the skillful and free-flowing craftsmanship of the artists. They draw on the essence of paper-cutting art, producing smooth and harmonious lines that balance softness and strength—both delicate and intricate outlines and bold, exuberant strokes—endowing the painted pottery with vivid vitality and a strong sense of movement.

Overall, the patterns, forms, and creative techniques of Jieshou painted pottery are deeply rooted in folk traditions, laden with unique local customs and rustic charm. The distinctive allure of Jieshou painted pottery lies not only in its superb craftsmanship and meticulous production process but also in its faithful inheritance and innovative expansion of traditional artistic spirit, as well as its profound exploration and recreation of folk cultural and artistic heritage.

Analysis of the Forms in Jieshou Painted Pottery Patterns

Plant motifs are the most widely used decorative patterns in Jieshou painted pottery, influenced by the local geographical environment and folk art. Common designs include peony patterns, chrysanthemum patterns, fennel petal patterns, and grass leaf patterns, all of which carry distinct local characteristics. The peony pattern typically centers around a full and plump flower, accompanied by curling and spreading leaves. It often follows a two-way continuous layout, with lively and natural lines that fully display the peony's elegant and magnificent demeanor. Notably, the chrysanthemum patterns are similar to peony patterns and are primarily realistic in style. Meanwhile, designs like scroll grass patterns, fennel patterns, and geometric patterns are mostly arranged in two-way or four-way continuous frameworks, creating a repetitive visual form with a unique esthetic effect.

Note that animal motifs in Jieshou painted pottery are generally derived from the Jianghuai region. These animal patterns rarely appear alone; they are often paired with cloud patterns, ground patterns, flowers, and other auxiliary elements to form a complete scene. Typical animal motifs include fish, birds, horses, and oxen, which are rich in local cultural flavor. For example, the fish pattern is depicted realistically, shaping a vivid and powerful fish outline with fluid and graceful lines. The fish motif also symbolizes good fortune and abundance.

Human motifs commonly include historical stories, opera characters, and maidservants. These are usually decorated using techniques like carving and floral detailing. The scenes are lively and rich in storytelling, reflecting the life scenes, folk customs, and vivid imagination of ancient people.

The highly regarded "warrior on horseback" motif in Jieshou's painted pottery is a prime example of this art form. Moreover, it typically depicts brave generals riding horses or fierce battle scenes, with bright and vibrant colors and smooth, flowing lines. This fully demonstrates the dynamic texture of the figures' skin and a strong artistic appeal, showcasing the outstanding creativity of folk artists and their profound traditional cultural heritage.

Color Analysis in Jieshou Painted Pottery Patterns

Jieshou painted pottery is renowned for its vivid colors and unique decorative patterns. The rich color palette and application in Jieshou pottery reflect distinct local characteristics and the esthetic preferences of the era. The colors used in Jieshou pottery patterns typically feature strong contrasts, including various glazes such as red, yellow, green, white, and black. After high-temperature firing, these colors produce bright and stable, magnificent hues. Therefore, traditional Jieshou pottery often employs the "three-color" or "five-color" glazing techniques, resulting in a layered and staggered visual effect on the pottery surface.

In specific pattern designs, color is not only limited to representational imagery but also carries deeper emotional significance and conveys symbolic meanings. For instance, red may symbolize passion and good fortune, green represents the vibrant forces of nature, and yellow often signifies fertile land and imperial authority. Through carefully arranged color combinations and meticulous filling techniques, the patterns on Jieshou's painted pottery vividly display the simplicity and vitality of folk art while deeply imprinting rich cultural heritage and the expression of auspicious wishes.

4.2 Overview of Shape Grammar Theory and Its Application in Jieshou Painted Pottery Patterns

The Origin and Development of Shape Grammar Theory

SG is a formal design theory and method that originated in the field of architectural design. It is used to describe and generate geometric shapes, structural layouts, and their combinatorial rules. The theory was first proposed by George Stiny, who drew inspiration from Avram Noam Chomsky's linguistic theories, particularly the concept of generative grammar, successfully adapting it to the analysis and creative design process of visual and spatial forms. Furthermore, SG describes the transformations and evolutions between shapes through a set of rules, allowing designers to systematically derive a series of two-dimensional graphics or three-dimensional works.

Basic Concepts and Principles of Shape Grammar Theory

As a design modeling tool, the primary task of SG is to establish a system of basic shape units comparable to a vocabulary in linguistics, encompassing a diverse range of elements from simple points, lines, and planes to complex aggregates. These elements form the foundational modules for all possible designs. Correspondingly, the generation and proliferation of shapes follow a recursive and non-linear logical structure: designers progressively build increasingly complex and refined geometric frameworks sequentially and cumulatively using basic elements and existing shape resources. This process is rich in branching and cyclic characteristics, resulting in a diverse spectrum of morphological outcomes. In addition, SG provides a framework that enables designers to manipulate basic shape units through abstract rules, systematically generating a series of shapes that conform to specific rules or aesthetic standards. According to George Stiny, SG is defined by a four-tuple formula: $SG = (S, L, R, I)$, where S is a finite set of shapes; L is a finite set of symbols; R is a finite set of rules; and I represents the initial shape. The shapes

generated by SG should be derived from the initial shape through the application of shape rules. At the same time, the derivation rules of SG can be divided into generative and derivative derivations. Notably, generative derivation creates new shapes by adding, deleting, replacing, or reorganizing geometric elements. Derivative derivation includes scaling, mirroring, copying, rotating, shearing, and Bezier curve transformations.

Application Design Process of Jieshou Painted Pottery Patterns

First, representative Jieshou painted pottery patterns are collected from related books, literature, and internet resources. Consequently, in-depth summarization and analysis of these patterns are conducted, and design factors such as main pattern styles, shape characteristics, and color features are extracted. Second, based on the extracted design factors, SG theory can be used to generate application patterns through generative and derivative derivations that align with contemporary design aesthetics. Finally, user needs are analyzed to apply the generated patterns to relevant cultural and creative products, forming products with distinct cultural characteristics of Jieshou painted pottery.

4.3 Jieshou Painted Pottery Pattern Application and Derivation Design

Determining the Objects of Derivation

By adopting both online and offline methods, a carefully selected collection of highly representative Jieshou painted pottery pattern samples was gathered as the core objects for derivation and analysis. Using computer software technology, the typical pattern characteristics exhibited by these Jieshou painted pottery samples were deeply explored and digitally sampled, specifically encompassing aspects such as their morphological structure and color analysis.

Extraction of Design Factors

In the pattern design of Jieshou painted pottery, the morphological factors mainly include three categories: geometric patterns, plant patterns, and animal patterns. Plant patterns are the most abundant, widely applied, and often ingeniously combined with other thematic patterns. In terms of color, Jieshou painted pottery draws on the glazing techniques of Tang Dynasty tri-colored pottery, using a variety of bright colors such as red, green, yellow, white, and blue to create strong contrasts and rich visual impact. Regarding pattern layout, Jieshou painted pottery strictly adheres to the principles of traditional Chinese aesthetics, achieving a balance of complexity and simplicity and an orderly distribution of density. This ensures the patterns are evenly distributed and varied, achieving visual balance and harmonious beauty.

Using graphic processing software (Illustrator), the "Pen Tool" was employed to outline and analyze the representative patterns of Jieshou painted pottery. Through meticulous digital processing techniques, six of the most representative morphological factors were successfully extracted from the complex patterns labeled H1, H2, H3, H4, H5, and H6 (see Table 1 for specific morphological factors). Similarly, the color picker tool in Illustrator was used to extract colors from four representative pottery jars labeled S01, S02, S03, and S04. Six color points were extracted from each piece of painted pottery, represented by CMYK values (see Table 2). This laid the foundation for further color analysis and design research.

Table 1
Extraction of Morphological Factors of Patterns




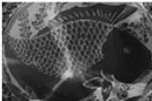














Pattern Material 1	Pattern Material2	Pattern Material3	wrinkles of fish	geometric pattern	Straw pattern
					
Figure1	Figure2	Figure3	Figure4	Figure5	Figure6
					
Form factor H1	Form factor H2	Form factor H3	Form factor H4	Form factor H5	Form factor H6
					

Table 2
Extraction Library of Initial Color Factors of Jieshou Painted Pottery Decoration



























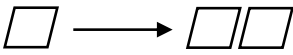
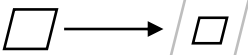
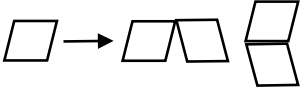
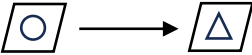
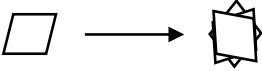
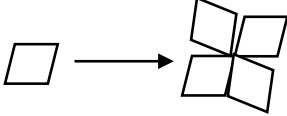
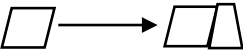
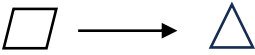
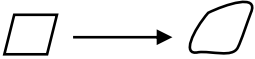
Serial No	Sample name	extraction zone	Color Extraction					
S01	Pottery jar with flower pattern		 C: 51 M:82 Y:85 K:32	 C: 81 M:52 Y:100 K:31	 C: 38 M:18 Y:47 K:0	 C: 54 M:67 Y:73 K:12	 C: 30 M:59 Y:46 K:0	 C: 25 M:60 Y:20 K:0
			 C: 87 M:58 Y:45 K:33	 C: 91 M:60 Y:100 K:42	 C: 85 M:5 Y:89 K:17	 C: 39 M:57 Y:68 K:0	 C: 51 M:67 Y:82 K:10	 C: 76 M:39 Y:75 K:1
S03	Pottery Jar with Figures		 C: 8 M:56 Y:75 K:0	 C: 45 M:96 Y:80 K:14	 C: 61 M:33 Y:69 K:0	 C: 33 M:50 Y:73 K:0	 C: 27 M:19 Y:27 K:0	 C: 28 M:67 Y:73 K:0
			 C: 53 M:90 Y:98 K:33	 C: 47 M:82 Y:100 K:14	 C: 56 M:95 Y:100 K:47	 C: 78 M:44 Y:87 M:4	 C: 65 M:63 Y:93 M:27	 C: 58 M:68 Y:82 M:22

Table 3
Rule Derivation Process

R1 Replication	R2 Resizing	R3 Mirroring
		
R4 substitution	R5 Center Rotation	R6 Endpoint rotation
		
R7 increase	R8 deletion	R9 Bessel curve
		

Derivation Design of Jieshou Painted Pottery Patterns

Using the basic morphological factors of Jieshou painted pottery patterns, derivation designs are conducted using SG, which includes generative and derivative derivations. The process is as follows:

Figure 1: Select morphological factor H2 from Table 1 as the research object; perform derivation design using SG. First, the H2 shape is imported into computer software. Execute the R8 (delete) command on Figure 1a to obtain Figure 1b. Consequently, the R5 (central rotation) command was applied to Figure 1b to create Figure 1c. This is continued with the R9 (Bezier curve) command on Figure 1c to smooth it further into Figure 1d. Simultaneously, the R1 (copy) and R3 (mirror) commands are applied to Figure 1d to obtain Figure 1e. Next, execute the R5 (central rotation), R1 (copy), and R3 (mirror) commands in Figure 1e to obtain Figure 1f. Proceed with the R1 (copy) and R3 (mirror) commands in Figure 1f to generate the basic Figure 1g suitable for use in corresponding cultural and creative products.

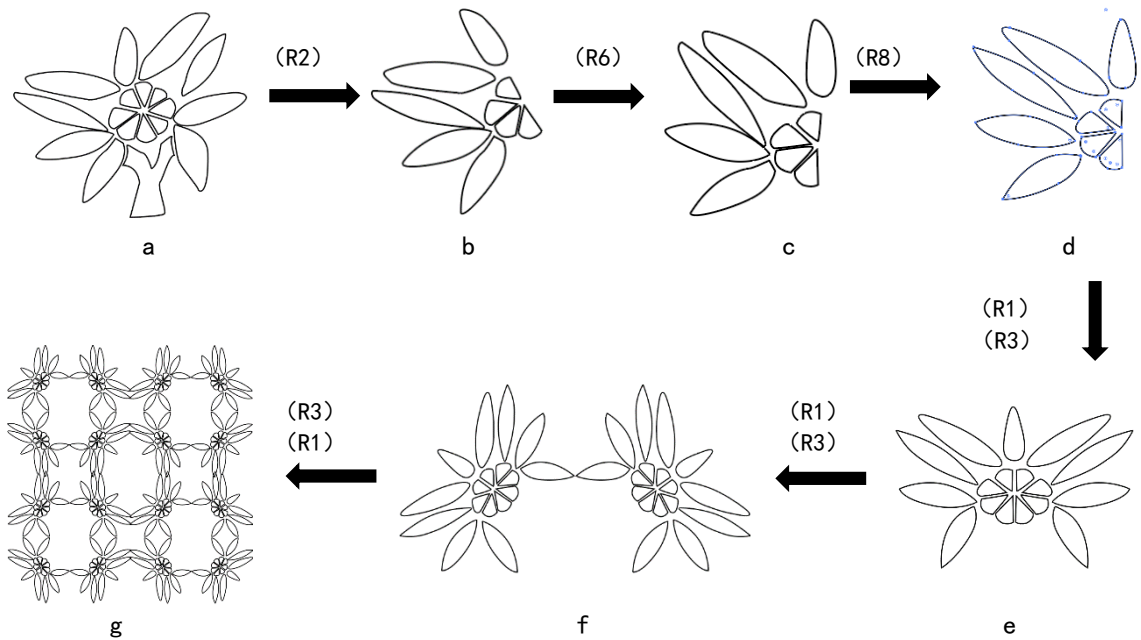


Figure 1. Jieshou Painted Pottery Pattern Derivation (Part One)

Figure 2: Select morphological factor H5 from Table 1 as the research subject; conduct SG derivation design. First, the H5 shape is imported into computer software. Execute the deletion (R8) command on Figure 2a to add or delete elements, resulting in Figure 2b. Apply a Bézier curve (R9) to Figure 2b to obtain Figure 2c. Mirror Figure 2c (R3) to create Figure 2d. Simultaneously, copy (R1) and mirror (R4) operations are performed in Figure 2d to produce Figure 2e. Correspondingly, the copy (R1) and mirror (R3) are executed to obtain the base Figure 2f, which is suitable for the corresponding cultural and creative products.

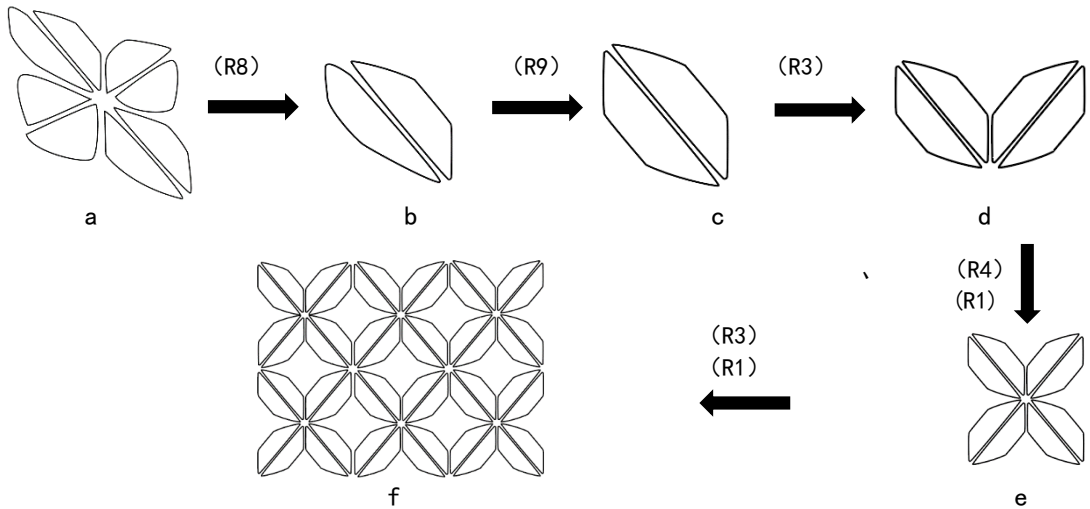


Figure 2. The Second Derivation of Patterns in Jieshou Painted Pottery

Figure 3: Select morphological factor H6 from Figure 1 as the research subject; conduct SG derivation design. First, the H6 shape is imported into computer software. Execute the deletion (R8) command on Figure 3a to create Figure 3b. Apply the rotation (R5) command to Figure 3b to obtain Figure 3c. Use the Bézier curve (R9) command on Figure 3c to produce a smoother Figure 3d. Perform copy (R1) and vertical mirror (R3) operations on Figure 3d to obtain Figure 3e. Continue with copy (R1) and mirror (R3) to generate the base Figure 3f, suitable for the corresponding cultural and creative products.

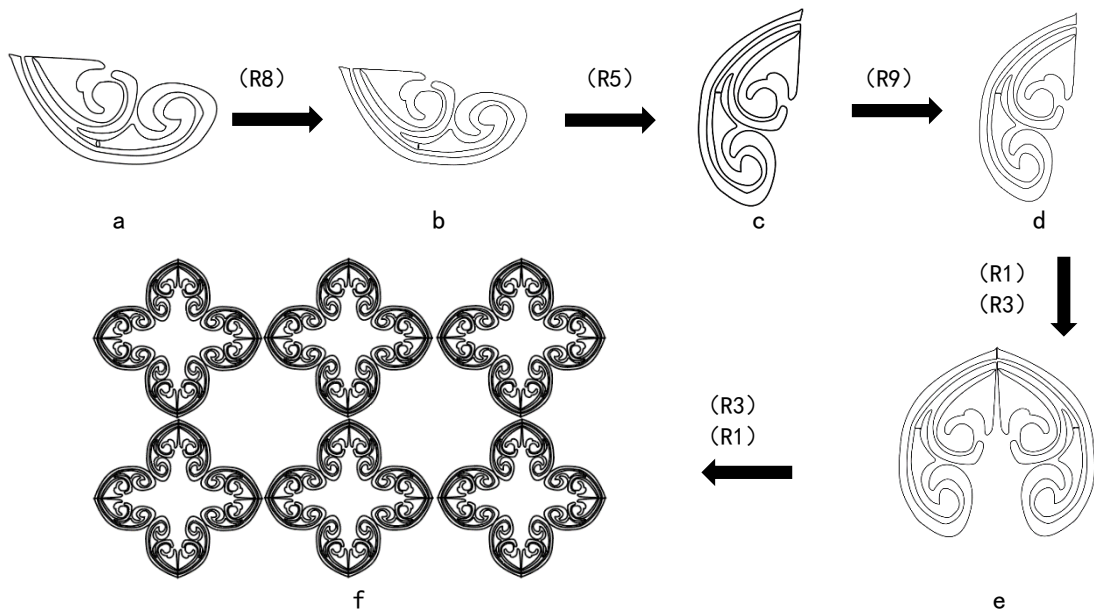


Figure 3. The Third Derivation of Patterns in Jieshou Painted Pottery

Figure 4: Select morphological factor H3 from Table 1 as the research subject; conduct SG derivation design. First, the H3 shape is imported into the computer. Execute the deletion (R8) command on Figure 4a to obtain Figure 4b. Continue with deletion (R8) and Bézier curve (R9) commands to obtain Figure 4c. Perform copy (R1) and vertical mirror (R3) commands on Figure 4c to obtain Figure 4d. Execute the addition (R7) command on Figure 4d to obtain Figure 4e. Finally, copy (R1) and mirror (R3) commands in Figure 4e are applied to generate the base Figure 4f, which is suitable for the corresponding cultural and creative products.

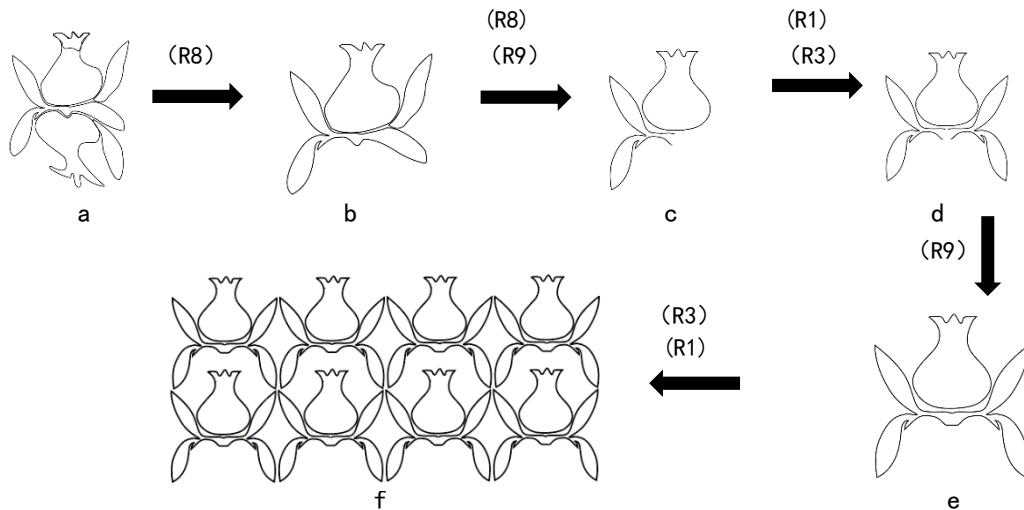


Figure 4. The Fourth Derivation of Patterns in Jieshou Painted Pottery

4.4 Design Application of Jieshou Colored Pottery Ornamental Culture Products

Jieshou colored pottery, as an ancient traditional art form, embodies profound cultural heritage and historical sediment in its ornamental patterns. Notably, integrating these patterns, marked by the traces of time, into modern cultural product designs preserves and inherits traditional cultural heritage. Moreover, it also revitalizes these traditional patterns with innovative design techniques, adapting them to contemporary esthetic demands and social environments.

Continuation of Cultural Genes

The ornamental patterns of Jieshou colored pottery, depicting a rich cultural landscape of the Chinese nation over the past millennium, encapsulate the wisdom and esthetic sense of generations of laborers and artists. Thus, incorporating these patterns into the design of cultural creative products essentially translates cultural genes deeply, allowing Jieshou colored pottery ornamental art to flourish and innovate in design mediums.

Expansion of Decorative Arts

The application of Jieshou colored pottery ornamental designs in modern cultural creative products represents a transformative reinterpretation of traditional artistic essence and symbolic meanings accumulated over the years. By skillfully integrating these patterns into contemporary cultural product design concepts, it maintains the purity and spiritual core of traditional cultural foundations while injecting fresh vitality and innovative thinking into the field of modern design.

Furthermore, this interdisciplinary design approach helps expand the influence of Jieshou colored pottery culture, exposing more people to and fostering an appreciation for this traditional art's charm in daily life. This practice also interprets Chinese traditional craftsmanship and folk art in a modern context, vividly showcasing the continuous evolution and innovative power of decorative arts across different cultural contexts.

Industrial Upgrading and Market Expansion

As a cultural symbol, Jieshou colored pottery ornaments enhance the cultural value and artistic taste of cultural creative products. In addition, it facilitates the transformation of the entire cultural creative industry from simple product manufacturing to brand building with cultural added value. This shift drives the improvement of related industry chains, including raw material supply, product research and development, design services, and marketing, among others.

The integration of Jieshou colored pottery ornamental designs into modern designs has successfully attracted a wide range of young consumers pursuing personalized and high-quality lifestyles, significantly expanding market share. Simultaneously, promoting Jieshou colored pottery ornamental cultural products in the international market showcases the charm of Chinese traditional culture, promotes cultural exchanges and cooperation, expands overseas markets, and facilitates the internationalization of the cultural creative industry.

Generation of Design Application Plans

By refining and evolving unique design elements of Jieshou colored pottery and combining them with in-depth market demand analysis, women's scarves are selected as the creative medium. Jieshou colored pottery, as an artistic gem rich in traditional Chinese aesthetics and regional cultural heritage, demonstrates extensive adaptability and innovation in the field of modern fashion design. When its exquisite patterns are ingeniously integrated into the blueprint of women's scarf designs, it undoubtedly creates a unique product series that combines classical charm with contemporary flair.

Derived from reimagined designs of accepted colored pottery ornaments, these patterns embody various profound cultural connotations, such as auspicious symbols of good fortune and longevity. When these meaningful patterns are reproduced and inherited in scarf designs, they transcend mere decorative function, elevating scarves into fashionable accessories with deep cultural significance, further enhancing their value in everyday esthetic and spiritual realms.



Figure 5. Product Application Visuals



Figure 6. Product Packaging Visuals

5. Discussion and Conclusion

Morphological grammar has infused new vitality into the innovative design of Jieshou painted pottery patterns. It not only provides designers with systematic theoretical support but also, by deeply analyzing the morphological characteristics and geometric composition of pattern elements, extracts basic morphological elements and combination rules that can be flexibly applied. This method effectively guides the generation of design elements, allowing designers to adhere to traditional esthetic principles while incorporating personal creativity, thereby achieving an innovative interpretation of Jieshou painted pottery art.

Hence, recreating Jieshou painted pottery patterns using SG tools means modern reconstruction on the basis of preserving traditional artistic style and cultural connotations. This attempt to combine traditional craftsmanship with modern design concepts not only breathes new life into ancient art but also endows it with broader practical and esthetic value. Consequently, it becomes a bridge connecting the past and the future, highlighting the unique charm of the perfect fusion of traditional culture and modern design.

Furthermore, applying morphological grammar to Jieshou's painted pottery pattern design also embodies the living heritage of traditional crafts. It encourages designers to explore and innovate on the basis of respecting and understanding tradition. Through continuous experimentation and practice, they can explore more possibilities in paper-cutting art. This creation, based on but transcends tradition, helps cultivate cultural confidence in the new generation of designers. It also promotes the effective dissemination and sustainable development of traditional cultural contexts in modern society.

In summary, integrating morphological grammar into the modern transformation design application of Jieshou painted pottery patterns enriches the traditional visual expression of these patterns and broadens their cultural communication and promotion paths. Accordingly, it substantially promotes the effective dissemination and living heritage of Chinese traditional cultural contexts in the contemporary setting.

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Conflict of Interest

The work described has not been submitted elsewhere for publication, in whole or in part, or is not under review process in another journal, and all the authors listed have approved the manuscript enclosed.

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ENHANCING CRITICAL AND CREATIVE THINKING THROUGH ENGLISH ORAL PRESENTATIONS IN ONLINE LEARNING: A CONCEPTUAL EXPLORATION

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ABSTRACT

The purpose of this conceptual paper is to highlight the effectiveness of English oral presentation for enhancing the university students' critical thinking skills and creativity in online learning. Critical thinking and creativity are among the two most important skills demanded among the university students, particularly during English oral presentations in classroom. Students may find the task challenging because they are required to initially read, research, plan, write and finally present ideas creatively and critically in English. They must be creative when producing their ideas, and support them critically with logical explanations, details, and examples in front of their friends and lecturers. However, when Covid-19 pandemic occurred, face-to-face and online learning were the approaches for students to learn and educators to teach. The implementation of e-learning in teaching and learning process could be a way to realize this goal where technological tools usage has provided new opportunities to enhance the students' critical thinking and creativity in delivering their English oral presentation. Thus, an in-depth literature review was conducted within the realm of both thinking skills in relation to students' oral presentation. In addition, a conceptual framework which connects the relationship between the educators' feedback and digital tools used to develop, stimulate, and engage students' critical thinking and creativity is proposed for further exploration. This study contributes to the current literature on both thinking skills and its effectiveness on the university students' English oral presentation while emphasising the need for more research in this area.

1. Introduction

Oral presentation is one of the most essential skills required for students in higher education and their future employability regardless of discipline or professional choice (Campbell et al., 2001; Morley, 2001; Thornbury, 2005 as cited in Iqbal et al., 2019). Students who possess oral presentation abilities can actively engage in their education, exhibit their communication skills, and gain knowledge in a field that will be useful in their future careers. Oral presentation, as defined by Levin and Topping (2006), is a planned and practiced speech that is introduced by a presenter to an audience, not memorized or read from notes. Apart from that, Salem (2019) refers to the oral presentation as a formal communication with activities which deliver information to a group and it provides an opportunity for students to apply a second language in interacting with others naturally. That is, students are given the opportunity to demonstrate their knowledge through oral presentations, which also serve as a reference instructor based on the students' comprehension (Tsang, 2020).

Fallows and Steven (2000) claim that to succeed in the future workforce, graduates need employability skills such as the ability to retrieve and handle information; to communicate and do presentation; to plan and solve problems; to involve in social development and interaction; and to think creatively, and critically. As Trilling and Fadel (2009) state, when graduates join the workforce, employers are looking for those who are having good critical thinking rather than having highly specialized academic skills. As a result, graduates must be prepared to analyze, assess, and integrate information from a variety of sources in order to solve problems and come up with workable ideas for potential solutions (Richard & Rebecca, 2010). Therefore, it is very important for students to have the ability to think critically in order for them to survive and succeed in the rapidly changing workplaces (Foo & Quek, 2019).

It is believed that these skills need to be incorporated into the academic curriculum in universities and the relevance is to teach students how to prepare, organize and deliver successful oral presentations for professional purposes. As supported by Salem (2019), since presentation skills are being used more and more frequently in professional and academic evaluations, they are considered essential in university-level English language preparation programs. Nearly every syllabus includes oral presentation assessments, especially for ESL/EFL courses at higher education institutions (Razawi, Zulkornain & Mohd Razlan, 2019) Hence, giving oral presentation is the best practice to develop students' speaking skills and encourage active learning (Živković 2014; Suardika et al., 2023).

Despite learning English for more than 11 years, most university students in Malaysia are still unable to speak the language confidently in classroom, especially when delivering their oral presentation (Muhamad et al., 2013). One of the skills that students find challenging is oral presentation in which they are required to read, research, plan, write and present (Muhamad et al., 2013). Furthermore, they also have difficulties generating ideas and developing sentences in the speaking process. In other words, as stated by Kenayathulla et al. (2019), students still experience great anxiety while giving oral presentations in the English language. Based on this problem, the inability to deliver ideas orally is due to the lack of critical thinking (Mohd Asraf et al., 2023; Aouaf et al., 2023). Mohd Ashraf et al. (2023) further support that it is important for students to apply critical thinking because there are a lot of ideas or opinions that can be expressed and thus, it helps them to speak confidently. Arum and Roska (2011) believe that 99% of educators agree that one of the most necessary objectives of university education is the development of critical thinking abilities.

Independent studies on critical thinking and creative thinking have been widely conducted on the factors (Akmam et al., 2019), relationship (Bagheri, 2018; Nukhairo et al., 2019), learning strategies (Wu & Wu, 2020), and problem based learning (Birgli, 2015). However, only few studies focused on both thinking skills in relation to online learning (Riadi et al., 2021; Basu, 2020). Thus, this study attempts to conceptually review the English oral presentation as a mechanism to improve university students' critical thinking and creativity in online learning. It explores the concept of online learning, digital tools, and educators' feedback as the missing elements in English oral presentation, which are seen as the effective ways to learn the language and be a better speaker.

2. Objective of the Paper

The main objective of this paper is to conceptualize the application of oral presentations as a mechanism to improve university students' critical thinking and creativity in online learning.

3. Literature Review

This review addresses the relevant concepts in relation to oral presentation skills, critical thinking, and creativity of university students in classroom as well as online learning.

Oral Presentation Skills

A study by Rahmat, Shahabani and Ibrahim (2020) revealed that some students are nervous about giving presentation in front of an audience because they believe that their knowledge is insufficient. They fear that they will be misinterpreted or that their message will not be understood. That is, students are afraid of oral presentation due to their own characteristics and the environment they are put in (Rahmat, 2019). On the other hand, Barrett and Liu (2019) investigated how English academic oral presentations via a blended language learning environment were designed by students. The results of the study showed that group oral presentations have improved, with stronger introductions, linking devices, and visual elements but students have problems constructing conclusions and linking the main ideas to the content.

Besides that, a study by Riadi (2020) focused on the impact of oral presentation in developing the students' ability to speak English. Furthermore, the researcher would like to know the students' difficulties in delivering their oral presentations in EFL classrooms of higher education context. The findings of this study revealed that the students' oral presentations do affect their speaking abilities. Meanwhile, Agustina (2019), investigated 32 students of the Accounting Department-State Polytechnic of Malang, Indonesia on their self-confidence and the ability to speak in English when presenting a business meeting project. The result revealed that most students show great improvement in their speaking skill due to their interest and strong motivation when participating in this learning activity. Meanwhile, a quantitative research conducted by Amir, Rahmat, Sim, Sukimin, Mohamad Radzi and Md Raus (2022) investigated on how common oral presentations are among second-language English learners. There were 56 respondents involved in this survey. The results indicated that internal and external factors contribute to the presenters fear of oral presentation.

Hence, oral presentations in English, particularly in online settings, simulate real-world scenarios where students must communicatively and convincingly express their views. Past studies demonstrated that the positive impact of oral presentations on critical and creative thinking skills

highlight how important they are in preparing students for workplace demands (Al Mamun, 2024; Dung, 2024).

Critical Thinking Skill and Creativity in Online Learning

Through history, the critical thinking concept has been studied and explored by different academicians and researchers (Enciso et al., 2017). There have been three approaches identified to define and integrate critical thinking into education and they are philosophical, psychological and educational approaches (Lai, 2011). Lai (2011) also defined from the field of psychology that critical thinking is a process which involves mental activities. As for the education field, critical thinking is used interchangeably with higher order thinking from Bloom taxonomy. However, Cáceres et al. (2020) argued that it depends on how the skill is used. This study agrees with John Dewey's point of view that critical thinking starts when students are engaged with a problem. Therefore, it is suggested the critical thinking can be defined as "an individual thought process that begins with the intent to solve a problem or to answer a question, by examining different options and choosing the most suitable and logical one" (Asleh, 2020, p.21).

Another skill that needs to be focused on is creative thinking skills. According to Lennon (2014), principles of critical thinking often include elements of creativity, curiosity, and deliberation. In addition, creativity is not confined to art only but is also expressed in academic and social situations through collaboration, sense-making, and meaning-making (Badger, 2019). According to Jankowska and Karwowski (2015), creativity can be understood as a synonym of divergent thinking alone, since it involves deductive and inductive thinking, as well as the use of problem-solving strategies to generate novel insights and solutions. A creative person exhibits originality in thought and ideas and sees things in new ways. As an illustration, Mahdia, Sukarmanb and Yokc (2015) had conducted a survey on 100 respondents who were the participants and non-participants of innovation, invention and design project, IID. Based on their findings, students who were the participants of the project were more confident, motivated communicative and were able to work in teams compared to those who did not participate.

Many past studies support that online learning is selected as a supportive media in developing the students' critical thinking and creativity (Zare et al., 2016). deNoyelles and Reyes-Foster (2015) in their study found that using word cloud in online discussion can prompt the act of problem solving. Meanwhile, Wardani et al. (2019) found that there is a significant and strong correlation between information system media and critical thinking skills. Meanwhile, a study by Hussin et al. (2019) suggested that online platform is better when lecturers start the discussion of tasks, ask questions, and encourage students to develop their critical and creative thinking. The students might require answering the questions posed. Besides that, according to Toshpulvatova and Kinjemuratova (2020), the main strategies needed to develop critical thinking skills are evaluating information, analyzing, logical reasoning, arguing, reflecting, and problem solving, and these strategies are significant to be enhanced in the academic English language classes.

Apart from that, Riadi et al. (2021) conducted a qualitative descriptive study on 74 students in one of the public high schools in Bandar Lampung, Class X SMA Negeri 9 Bandar Lampung, Indonesia. The researchers investigated how students' critical thinking and creativity were empowered in online learning during the Covid-19 pandemic. They found that teachers need to design online learning to assist students to empower both their thinking skills and interact actively between them and the students. Thus, since online learning environments are becoming more and more common in educational institutions across the globe, it is crucial to include CT skills into these learning setting (Bachtiar, 2024).

English Oral Presentations as a Tool for Enhancing University Students' Critical Thinking and Creativity in Online Learning

Previously, students learned and did oral presentations in classroom but today, educators and students begin to shift their mindset into using technology in teaching and learning process. Due to this reason, new discoveries and digital tools have been constantly expanding, which has led students to become more creative as well. As Nussbaum et al. (2021) emphasized the importance of critical thinking and creativity in online learning, where they specifically highlight the potential for technology to facilitate the development of these skills.

It is believed that to survive in this competitively changing world, the most crucial skills to be developed are critical thinking and creative thinking because these abilities are beneficial for personal, educational, and economic growth (Chen, 2013). He further stated that to be a better thinker, these two thinking processes need to be combined. In addition, Henriksen et al. (2016) also suggested that it is significant to explore the relationship between these two constructs across varied, global educational contexts. According to Zubaidah (2018), all graduates must have the 4Cs—creativity, cooperation, critical thinking, and communication to succeed in the Revolution Era 4.0. In fact, higher education is gaging towards the need of 21st century demand in producing professional students who are not only excellent in academic but are also critical and creative in solving problems. Kabilan (2000) claimed that students can only become proficient language users if they are able to demonstrate creative and critical thinking through the language, apart from using it and knowing its meaning. That is, they must be creative when producing their ideas, and support them critically with logical explanation, details, and examples. As Husna (2017) asserted that critical thinking skills need to be developed in order one to be creative.

Undoubtedly, electronic technologies usage has led to the development of educational opportunities and thus, it helps students to develop their skills (Zare et al., 2016). Robilos (2021) conducted a study on 30 intact groups of students who were using LoLooNote digital graphic organizer (digital GO) for their oral presentation in a public university in Thailand. The result indicated the digital GO usage increases not only the students' oral presentation performance but also their critical thinking skill. Meanwhile, Elyana et al. (2018) did a pilot survey on 35 respondents utilizing digital technology for a project presentation. They found the digital technology and software usage enhance the students' creativity and confidence. As supported by Hussin et al. (2019), the increasing use of technologies in learning institutions, particularly during online learning, has changed the way students' study, interact, and think.

Importance of Feedback and Students' Engagement

Generally, giving and receiving feedback after the presentation is considered useful to students. They will receive feedback from their lecturers after their oral presentations. An experimental study by van Ginkel et al. (2019) examined the first-year undergraduate students who practiced their presentations in a virtual environment. They received feedback produced by the system, on their presentation competence components such as cognition, behaviour and attitudes. The researchers also investigated the effectiveness of a virtual reality-based task for delivering the feedback. Furthermore, a study by van Ginkel et al. (2020) was conducted with 22 pre-university students enrolled in a presentation skills course within a Dutch secondary education curriculum in the school year of 2018. The participants were categorised into two feedback conditions: immediate and delayed. Results of the study indicated students in both groups made

significant development in all presentation criteria across the two-week programme. This helps the students to develop communication skills within the group and relate to 'action learning' processes in which a student works in a group on real world challenges, becoming more critical throughout the process (Charlesworth, 2018). A study by Xu et al. (2021) investigated the role of educator's feedback in an online business English presentations during the Covid-19 pandemic. It was found that EFL learners' attitudes were quite positive toward the educator's feedback. As supported by Ndolo (2021), higher education educators can effectively give feedback to students in an online learning environment that fosters their ability to think critically and creatively.

Besides that, students' engagement and participation are important to ensure the effectiveness of online oral presentation. During online presentation, students should contribute ideas and apply creativity without being influenced by others. By doing this, engagement may lead to a more systematic and critical way of thinking. Besides that, Ho (2022) believed it is significant to integrate and implement the online peer review into undergraduates' oral presentations. The main purpose of the integration is to bridge the gap between tertiary education and the workplace, equipping students with better oral presentation skills. As a result, they could learn and improve their oral presentation throughout the semester in online English classroom. Besides that, a study by Gokgoz-Kurt (2023) investigated a total of thirty-two university students who used an online platform to provide feedback anonymously on their classmates' oral presentations over a four-week period. They enrolled in an upper-intermediate to advanced-level rhetoric and oral communication class. The researcher intended to learn more about the types and targets of peer feedback provided by EFL speakers, as well as their opinions and experiences with mobile-assisted peer feedback. The results showed that the students' feedback mostly covered positive comments than negative ones. The three main categories covered by both types of feedback are oral presenting skills, speaking performance, and presentation content.

Based on the literature above, there is a need for conceptualizing the application of oral presentations as a mechanism to improve university students' critical thinking and creativity in online learning.

4. PROPOSED CONCEPTUAL FRAMEWORK

Based on Figure 1, the proposed conceptual framework for this study describes the relationships between the concepts of these six (6) constructs: 1) critical thinking, which is the ability to analyze, evaluate, and synthesize information logically to make reasoned judgments and solve problems effectively; 2) creativity, is the capability to generate original ideas, innovate, and approach problems or tasks in new, imaginative ways; 3) educators' feedback refers to constructive responses and guidance provided by teachers to support the improvement of students' learning, development, and performance; 4) digital tools usage is the digital technologies integration and application such as software, apps and online platforms to enhance teaching and learning, 5) oral presentation is defined as the skill of delivering effectively spoken content to an audience with clarity, organization, and confidence; and 6) online learning refers to a mode of education where students use digital platforms via the internet to access courses and learning materials and engage in remote or virtual instruction.

This framework intends to integrate the educators' feedback and digital tools usage as these could develop, stimulate, and engage students' complex thinking process skills in delivering their English oral presentations. Digital tools such as learning management systems (e.g., Google Classroom, Ufuture), and online platforms (e.g., Google Meet, Microsoft Teams) facilitate educators' feedback by making the process more efficient, accessible, and interactive. For instance, real time feedback often applies whenever students are using video conferencing

platforms like Google Meet, Zoom or Webex for their online presentation. That is, educators can directly comment on the tasks, offer corrections, suggestions, and praise during or immediately after the presentation. In addition, this enables educators to provide timely, personalized, and detailed feedback to students while they are presenting. By receiving constructive feedback through digital platforms, it allows students to continuously revise and refine their arguments and reasoning and experiment with new ideas like trying new presentation styles using Canva. This helps students to evaluate their work critically and encourage them to think outside the box, promoting both critical thinking and creativity. This indicates that digital communication is particularly relevant as it becomes more integral in both academic and professional contexts.

The cognitive skills which are the students' critical thinking and creativity need to be enhanced as they engage in their English oral presentation in online learning. As supported by Saleh (2019), the concept of critical thinking is applicable to all areas of knowledge and encourages learners to engage in the process of knowledge creation and deep reflection. This directly supports the notion that digital tools and feedback can promote students' critical thinking by providing opportunities for reflective practice during oral presentations. For example, by using video feedback tools, students can reflect on their presentation performance, which engages them in self-assessment and analysis of their own content and delivery. This reflection fosters students' deeper engagement with their materials, thus sharpening their critical thinking skills. Besides that, Meyers (1986) identified four (4) main elements which support the critical thinking development; a) stimulating students' interest, b) creating meaningful discussion, c) exposing students to ideas and viewpoints of others, and d) fostering a supportive and trusting atmosphere.

These elements strengthen the role of educators' feedback in this conceptual framework. Students' critical thinking can be directly stimulated by timely, constructive, and supportive feedback that push them to rethink their ideas, sharpen their reasoning, and examine different points of view. This aligns with the framework which uses feedback as a tool to stimulate critical thinking and creativity in students as they develop their oral presentation abilities. Therefore, the relationships between critical thinking, creativity, feedback, and digital tools usage can be directly informed by Salleh's (2019) and Meyer's (1986) findings which further integrate these ideas into the framework.

The ability to think critically and creatively is essential not only in an online learning environment but also in the 21st century workplace. These skills prepare students by being more innovative, problem solvers and adaptive to new situations in order to face real-world challenges. As the framework indicates, digital tools and feedback support the development of students' critical thinking and creativity in their oral presentation, which are relevant in both academic and professional settings. The proposed framework can significantly improve students' critical thinking and creativity, which will benefit their academic achievement and future professional skills.

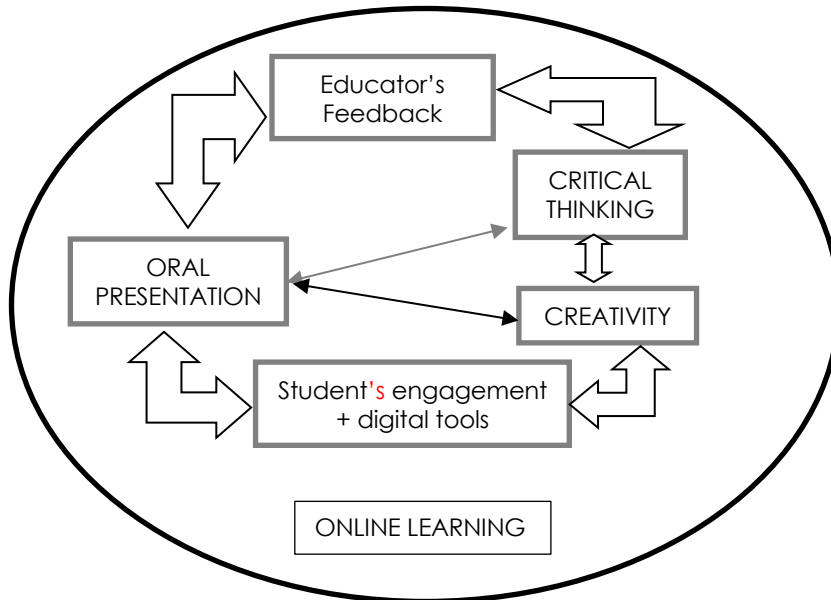


Figure 1. Proposed Conceptual Framework

5. Conclusion

This conceptual paper on the application of oral presentations as a mechanism to improve university students' critical thinking and creativity in online learning is far from being comprehensive. The concept of critical thinking and creativity is relatively less studied as the measures of these skills depend on subjective indirect display of behaviour from the source. However, the study on both skills is significant as it provides an insight into the underlying issues that affect the university students' English oral presentations in online learning. The trend is that today, many higher educational systems have transitioned to online learning underscores the need for studies that explore effective methods for teaching critical and creative thinking in such environment. Past literature which identifies oral presentations as a key tool for fostering both critical and creative thinking (Ati & Parmawati, 2022; Al Mamun, 2024) is thus highly relevant in the current context where many institutions are emphasizing online learning. It is recommended that future researchers will be able to improve the ability of online learning management systems so that university students can better deliver their English oral presentations. As for the lecturers, it is crucial for them to improvise their teaching strategies to help students increase both their critical and creative thinking skills, particularly in their oral presentation

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Conflict of Interest

No conflict of interest associated with this publication.

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A STUDY OF BABA-NYONYA'S EMBROIDERY STITCH TECHNIQUES IN THE LATE 19TH-EARLY 20TH CENTURY

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ABSTRACT

Baba Nyonya is a unique community in Malaysia, as their lifestyle seamlessly integrates Malay and Chinese cultures. The traditional dress and houseware adorned with Baba-Nyonya embroidery carry specific cultural connotations. There is still an unabated demand for Nyonya traditional embroidered clothing and accessories both locally and globally. This article explored the stitching techniques of Baba-Nyonya traditional embroidery in late 19th-early 20th century. The methods employed by researchers include fieldwork, analysis of physical items and images. It was found that there were seven stitching techniques of BaBa-Nyonya's embroidery which was often applied to traditional attire. The coiled gold embroidery and bead embroidery were two the most distinctive among seven stitch techniques. These stitching techniques incorporated features from Malay, Chinese and Western cultures. The younger Peranakan generation actively inherits and practices Nyonya embroidery skills, allowing them to connect with their identity and cultural heritage.

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1. Introduction

According to the history, the existence of Baba Nyonya ethnicity could be principally dated back to the 15th century (Khoo,1996). This Straits-born Chinese community known as

Peranakans (else known as Baba Nyonya) is a result of mix-marriage between the Chinese and the Malay people (Azam Azmi et al., 2018). The Peranakan men are commonly called BaBa, and the women called Nyonya (Kim, 2008). Baba Nyonya community has developed from being the initial communication between the Chinese and the Malays in the state of Malacca, which is the original center of the Baba Nyonya culture, when Penang and Singapore became developed and progressed, many Baba Nyonyas moved to these two states. They formed a unique hybrid identity expressed in their fused cultural traditions, language, religion, fashion, foodways, social etiquette, architecture and material culture (e.g., jewellery, porcelain, embroidery and beadwork (Henderson, 2003).

Straits Chinese, Strait-born Chinese, Peranakan, Peranakan Chinese and BaBa Nyonya all referred to the same people, which described the BaBa Nyonya community in Malaysia (Wee, 2011). Those who settled in what eventually became the British Straits Settlements of Penang, Melaka, and Singapore were also known as Straits Chinese; their men were called Babas and women Nyonyas. In the last century BaBa Nyonya mainly lived in Malacca, Penang and Singapore (Sankar et al., 2016). So, this article focused on BaBa Nyonya in Penang, Melacca, and Singapore.

To the Nyonya, the family household was the only world that mattered, they were expect to learn domestic arts such as cooking, cleaning, embroidering and crafting under the tutelage of their mothers, grandmothers or aunts (Seri, 2012). They spent much time on sewing clothes, shoes, purses, wedding bed drapes, etc. with brightly colored silk and embroider flowers and plants on them, using hand embroidery and openwork methods in their crafts. According to Kim (2008), the kebaya sulam with its elaborate embroidery used to take six months to make by hand in the past. But in modern times, many descendants of BaBa Nyonya have not been aware of their special ethnic identity since they were born, they have opted for western dress in their everyday life (Wee, 2011). Growing up in a globalized and modernized society, some of the younger generations of BaBa Nyonya have not even had the opportunity to be exposed to or be told about their own BaBa Nyonya culture. This study is important because it is the effort to understand the culture of the arts of a nation has led the younger generation to pass it on.

2. Literature Review

Embroidery is a craft of decorating fabric or other materials using a needle to apply threads. According to (Sharma & Rao, 2019), there are variety of threads based on their aesthetic and functional qualities like cotton, silken, twisted and untwisted etc. Sometimes embroidery can also be combined with other materials such as sequins, quills, beads and pearls. Embroidery generally is viewed by people as a form decoration or embellishment but its origins may lie in the decorative stitching together of leather or woven cloth as well as in the strengthening of cloth (Dhamija, 2004). Embroidery has a long history that can date back thousands of years. For example, the buttonhole stitch, which is still in use today, dates back to at least 8,000 B.C.E. Needles with eyes have been found as far back as 30,000 B.C.E. while clothing decorated with stone beads and animal teeth dates back even farther, to 38,000 B.C.E (Schoeser, 2022).

The embroidery was carried out across the Straits Settlements. BaBa Nyonya embroidery is a unique handicraft art with patterns and techniques influenced by both Chinese and Malay cultures. BaBa Nyonya embroidery first originated in the Malacca region (Ahmad et al., 2019). During the 19th and early 20th centuries, it evolved into a popular handicraft art. The embroidery patterns of BaBa Nyonya are often ornate and elaborate, which are decorated with gold and silver threads, beads, scraps of silk, wool and ribbons (Meng, 1987).

Embroidery played a significant role in the lives of the Nyonyas. Young Nyonya are expected to

be skilled in needlework and embroidery, and the value of a girl's dowry is usually determined by the quality of her embroidery. Nyonyas paid great attention to the quality of materials and craftsmanship used in their embroidery work, and they were also very good at new ideas and methods. The most iconic of these is the Peranakan style, which is often embroidered in bright colours, with an emphasis on symmetry and balance, and includes a variety of botanical, animal and geometric designs (Yong, 2017).

The stitch techniques are interconnected and embroidery stitches can be found in the different techniques (Draper,2022). Stitch direction is one thing you have to understand, to know why it is that certain stitches are occurring in a given locality. Generally in India you stitch away from yourself and in the UK generally towards yourself (Morrell,2006). It is important to observe people stitching to see the way they move the fabric around. it does become at times necessary to turn the fabric, this is not apparent when you are just looking at the finished stitch on the cloth (Fortelny et al., 2022). The techniques of the automatic embroidery machines are based on traditional embroidery stitich techniques, such as computer machine embroidery (Dai,2021), embroidered textile strain sensors (Colli Alfaro,2023), Machine Embroidery CAD System (Lim, J., & Heo, 2022) and so on.

These were primary components while executing embroidery which included, stitch type, direction of stitches and outline stitch(Arora et al.,2014)).Since stitches are constructed only by threads, the thread distributions should be more complicated than those of the existing art maps which only include parallel or vertical strokes, in order to convey different image contents(Yang et al.,2018).The stitch techniques of the allow artists to create intricate and beautiful patterns on fabric. Different stitching technique can produce varied textures, shapes, and line effects, providing artists with a comprehensive means to express their creativity. BaBa-Nyonya's embroidery is often considered a symbol of Peranakan culture. Wearing items adorned with embroidery helps BaBa Nyonya community and individuals establish a sense of identity in society.

3. Methodology

Since the subject of this article is from the past, this descriptive qualitative research employs a philological method and field survey images to interpret the Stitching techniques of Nyonya embroidery. As recommended by Charles Busha and Stephen Harter (1980), the following steps of this article methodology such as literature review method, field investigation method, sample selection and data analysis.

3.1 Literature review method

The literature review method refers to obtaining the required information and data for research by reviewing literature and documents (Wasserfuhr, 2022). This method can be used to analyze data related to historical events, social phenomena, institutional regulations, and so on. Literature review method can obtain literature materials through electronic databases, libraries, and the internet (Cooper et al., 2018).The research began with the data collection from secondary sources, including documents, books, master's theses, doctoral dissertations and journals related to Straits Chinese BaBa Nyonya and Baba-Nyonya's Embroidery in the late 19th-early 20th century.

Based on the literature review, some representative books and literature are covered, such as "Straits Chinese Embroidery&Beadwork", "Nyonya Needlework Embroidery and Beadwork in the Peranaka World", "the nyonya kebaya: A Century of Straits Chinese Costume", 'Sketch&Stitch: Interactive Embroidery for E-textiles', "Embroidery- An Embellishment on Women 's wear", 'Sustaining Baba-Nyonya Cultural Heritage Products: Malacca as a Case Study', 'Defining the

Aesthetics of the Nyonyas Defining the Aesthetics of the Nyonyas' Batik Sarongs in the Straits Settlements, Late Nineteenth to Early Twentieth Century, Chinese Culture and Customs in Peranakan, Funerals in Malaysia and Singapore, and others. Chinese Culture and Customs in Peranakan', 'Funerals in Malaysia and Singapore', etc. A systematic understood clothing items and household items of Malacca, Penang, and Singapore's Straits Settlements in the late 19th-early 20th century, as well as their embroidery on clothing items and household items. These provide the basis for subsequent summaries of the types of Nyonya embroidery and analyses of the various stitch techniques of the period. Through reading a large amount of literature, it was found that the stitch techniques of BaBa Nyonya embroidery could be analyzed in the characteristics of the various stitches and the embroidery applications in Straits Chinese lives.

3.2 Field investigation method

The data sources of qualitative research methods can be existing literature and data, as well as data obtained through fieldwork (Njie & Asimiran, 2014). This study collected primary sources from fieldwork, including objects, documents and photographs. Collecting as much relevant information as possible from field studies, describing various types of Nyonya embroidery among the Straits Chinese in the late 19th to early 20th centuries. The fieldwork sites were the Straits Settlements that are Baba&Nyonya Heritage Museum in Malacca, Pinang Peranakan Mansion in Penang, Peranakan Museum in Singapore.

Through field investigation at Baba&Nyonya Heritage Museum in Malacca, Pinang Peranakan Mansion in Penang, Peranakan Museum in Singapore, most of the objects, documents and photographs of BaBa-Nyonya embroidery in these museums were taken in the late 19th or early 20th century. The types of BaBa Nyonya embroidery in the Straits Settlements were described and initially categorized into three types of Nyonya embroidery. Based on careful observation of the Nyonya embroideries in the museum and discussion with the professionals in the museum when authors did not understand something, the main author found out the characteristics of the stitch techniques of Nyonya embroideries at that time. For example, the satin stitch is the basic stitch; couched stitch and bead embroidery are the two most characteristic embroidery techniques of BaBa Nyonya embroidery.

3.3 Sample selection

After Various secondary and primary sources were selected from different sources related to Baba-Nyonya's embroidery to gain a comprehensive understanding. The secondary sources mainly include books, master's theses, doctoral dissertations and journals related to Straits Chinese embroidery, and the details of these sources were carefully read. Primary sources were derived from fieldwork, and the samples had to meet all three of the following criteria: the Nyonya Museum, dating from the late 19th or early 20th century, and having embroidered textile objects or pictures. The samples selected for the fieldwork were: textile embroidery objects and pictures from the late 19th century or early 20th century in Baba&Nyonya Heritage Museum, six objects containing embroidery were identified and selected from large number of pictures taken, which consisted of apparel, accessory and houseware. Textile embroidery objects and photographs from the late 19th or early 20th century in Pinang Peranakan Mansion. Eight objects with extensive embroidery were identified and selected from lots of photographs taken, and the six objects included apparel, accessory and houseware. Textile embroidery objects and photographs from the late 19th or early 20th century in Peranakan Museum which is located Singapore. Five objects were identified and selected from plenty of photographs taken of apparel, accessory and houseware.

3.4 Data analysis

After Data Collection, the researcher needs to organize and analyze the material. Organizing and analyzing data refers to the systematic and organized process of focusing and condensing the raw data according to the research purpose, and ultimately interpreting the meaning of the data (Ngulube, 2015). Organizing and analyzing data is a crucial part of the research, as it involves seeking meaning and interpretation in the raw material. Selecting and organizing the most pertinent information collected, explaining the stitch techniques of various types of BaBa-Nyonya embroidery in the late 19th-early 20th century and these embroidery stitches were used in their daily lives. There are many unnoticed aspects of embroidery stitch techniques. Embroidery stitch technique characteristics were observed through a detailed study of embroidered textiles from the late 19th and early 20th centuries in the collections of Baba-Nyonya museums throughout Malaysia and Singapore. Technical features are the main components of embroidery such as stitch direction, outline stitches and colors. Stitch techniques of the Baba-Nyonya's embroidery were discussed in detail in this study.

4. Results

4.1 The Category of Baba-Nyonya's Embroidery

The embroidery of Baba Nyonya is a unique handicraft originating from the Peranakan culture in Malaysia and Singapore. It is clear that Baba Nyonya's embroidery works typically span various fields such as apparel, accessory, and houseware. The data collected from field surveys conducted at Baba&Nyonya Heritage Museum in Malacca, Pinang Peranakan Mansion in Penang and Peranakan Museum in Singapore. These embroidered works are all from the late 19th-early 20th century during the Straits Settlements Baba-Nyonya hand embroidery, showcasing rich Peranakan cultural characteristics and the exquisite craftsmanship of hand embroidery.

Baba Nyonya's embroidery is often applied to traditional Peranakan attire (Seri,2012). These garments may include ceremonial wedding robe, wedding skirt, embroidered jacket, kebaya, and attire for other special occasions (Tong,2015). The embroidery is typically presented on the clothing with rich colors and intricate patterns, adding a unique charm to the wearer. Baba Nyonya's embroidery is also widely used in various accessories such as hats, headbands, collars, belts, shoes, wallets, handkerchiefs, and more (Cheah,2017). Nyonyas typically use these accessories to complement the traditional attires, highlighting the overall look's delicacy and elegance. Baba Nyonya's embroidery is also commonly found in housewares such as altar tablecloths, bed curtains, pillowcases, embroidered paintings, and more. Through exquisite embroidery craftsmanship, these items bring a unique artistic atmosphere to the home space, reflecting the owner's appreciation for traditional culture.

Table 1
The Category of Baba-Nyonya's Embroidery

Apparel	Accessory	Houseware
		

Wedding robe
Baba&Nyonya
Heritage Museum



Wedding skirt
Baba&Nyonya
Heritage Museum



Embroidered jacket
Baba&Nyonya
Heritage Museum



Wedding robe
Pinang Peranakan
Mansion

Wedding handkerchief
Baba&Nyonya Heritage Museum



Collar
Peranakan Museum (Singapore)



Spectacle case
Pinang Peranakan Mansion



Woman's headband
Pinang Peranakan Mansion

Altar tablecloth
Baba&Nyonya
Heritage Museum



Canopy bed curtain
Pinang Peranakan Mansion



Curtain ties
Peranakan Museum
(Singapore)



Pillow cover
Baba&Nyonya
Heritage Museum



Kebaya (Pinang)
Pinang Peranakan
Mansion



Flat-nose slippers
Peranakan Museum (Singapore)



Embroidery panel
Pinang Peranakan Mansion



Kebaya
Peranakan
(Singapore) Museum



Bead embroidery bag
Pinang Peranakan Mansion



Embroidery painting
Pinang Peranakan Mansion

4.2 The Stitch Techniques of Baba-Nyonya's Embroidery

In the late 19th-early 20th century, BaBa Nyonyas used various stitching techniques to embroider the aforementioned works. These stitching techniques were delicate and unique, expressing rich patterns and a three-dimensional effect in the embroidery (Day et al., 2008). Here are some common stitching techniques of BaBa-Nyonya's embroidery.

Satin Stitch

The satin stitch, also known as straight stitch, is one of the basic stitching techniques in Baba-Nyonya's embroidery. From Figure 1, the basic operation of the satin stitch involves starting the thread from one side of the pattern outline, pulling it straight across to the other side, and then bringing the needle down. Following the pattern outline, the design is filled using straight lines. In satin stitch, parallel or radiating stitches were worked together, completely covering the ground material both back and front (Fumiyasu et al., 2016). The satin stitch is widely utilized in Baba-Nyonya's embroidery of the Straits Settlements. It is particularly suitable for areas of the design that require flat color blocks, such as floral elements, plants, figures, and text.

It is clear from Figure 2 that the direction of the satin stitch can be categorized into horizontal, vertical, and diagonal, all requiring achieving a flat, even, smooth, and continuous result. "Flat" implies that the embroidered surface should be smooth without irregularities; "Even" means the stitches should be evenly spaced, without overlap, crossing, or showing the base fabric; "Smooth" indicates that the needle should move smoothly along the pattern; "Continuous" means the stitches should follow the form of the pattern. In Baba-Nyonya's embroidery, when representing mountains, stones, or fruits growing vertically, or when creating compositions in a vertical direction, the vertical satin stitch is often used. When depicting vines, branches, or objects with winding and twisting growth patterns, the diagonal satin stitch is more commonly employed. Additionally, the diagonal satin stitch is often applied to embroider text. In Figure 3, the embroidered houseware curtain from the Pinang Peranakan Mansion uses a vertical-horizontal satin stitch direction for depicting figures and a diagonal satin stitch direction for depicting flowers and leaves.

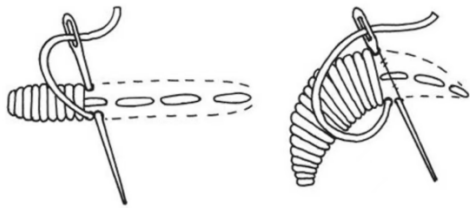


Figure 1. The satin stitch

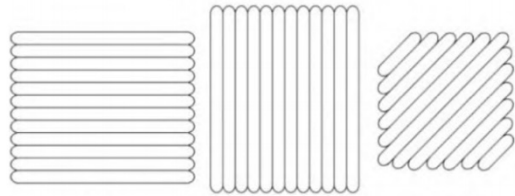


Figure 2. The direction of the satin stitch

The characteristics of the embroidery produced using the satin stitch in Baba Nyonya culture are intricate, and rich in texture. Satin stitch embroidery, although appearing simple, showcases a diverse range of effects due to variations in stitching techniques, differences in color styles, contrasts between different textured fabrics and threads, and the integration with other embroidery methods. The resulting pieces exhibit meticulous attention to detail, capturing the finest nuances and textures, contributing to a visually rich and varied artistic outcome.



Figure 3. The satin stitch of canopy bed curtain

Long and Short Stitch

Long and short stitch is also a fundamental embroidery technique in Baba-Nyonya's embroidery, involving the alternating use of long and short stitches on fabric. When employing the long and short stitch, it can be worked from the inside out or from the outside in. From Figure 4, in the first row, long and short stitches are alternately arranged, where a long stitch is followed by a short one. In the second row, stitches of equal length are irregularly spaced, inserted into the gaps of the first row. The third row and subsequent rows continue this pattern, with the middle

rows all using stitches of equal length. Only the outermost and innermost rows maintain the alternating pattern of one long stitch followed by one short stitch. This technique creates a textured and gradient effect in the embroidery (Harlaar et al., 2010).

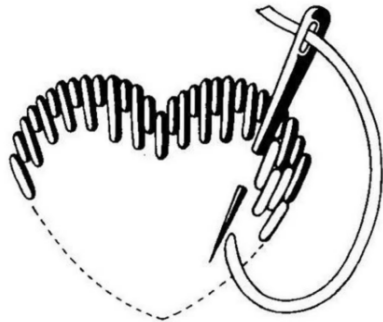


Figure 4. The long and short stitch



Figure 5. Embroidery painting

The long and short stitch technique involves layering one stitch over another. Through the layering of stitches and transitions in color, this technique allows for a seamless gradient effect in patterns, achieving a smooth and subtle transition between colors. In Figure 5, Baba-Nyonya's embroidery often employs the long and short stitch to fill in the feathers of animals, the petals of plant flowers, or other patterns with curves, creating a beautiful and nuanced gradient effect.

Backstitch

The backstitch technique involves short and dense stitches where each stitch is closely connected, creating a consistent length. This technique serves to reinforce the fabric (Arora et al., 2014). The stitches unit of the backstitch appear like grains, forming a connected line. In Baba-Nyonya's embroidery, this technique is often used for decorating outer edges and borders.

From Figure 6, the Baba-Nyonya's backstitch technique involves the embroidery needle coming up from below for the first stitch, pulling tight; then, moving back one stitch length (about 2-4mm) and going down from above for the second stitch, pulling tight; and then, moving forward two stitch lengths and coming up from below for the third stitch, pulling tight; and so on in a continuous loop. The backstitch has short and dense stitches, each stitch connected to the next with consistent length, providing reinforcement. The stitches unit of the backstitch appear like grains, forming a connected line. In Figure 7, Baba Nyonyas used the backstitch technique to decorate and reinforce the outer edges of the floral pattern in the spectacle case from the Pinang Peranakan Mansion.

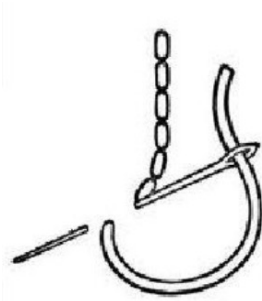


Figure 6. The backstitch



Figure 7. Spectacle case

Stem stitch

The stem stitch is similar to the backstitch. As shown in Figure 8, when embroidering with the stem stitch, the second stitch comes out at the midpoint of the first stitch, and the needle closely follows the trace of the first stitch. After every other stitch, the needle is pulled back, creating a rolling effect where one stitch follows the other. During embroidery, except for the first stitch, both the needle-up and needle-down hands are on the fabric, making the embroidery process convenient and fast, but the stitches may not be tightly packed.

The stem stitch is used to represent curves, also known as the curved stitch. It consists of short lines interconnecting to form a continuous and rotating effect. The stem stitch is frequently employed in Baba-Nyonya's embroidery to depict water patterns, clouds, willow branches, and is effective in outlining the stems of plants from Figure 9 that is from Pinang Peranakan Mansion. It is also commonly used to portray the curved antennae of butterflies, whiskers, eyebrows, and mane of dragon heads, among other details.



Figure 8. The stem stitch



Figure 9. Pillowcase

Knot Stitch

The knot stitch is a type of dot embroidery, also known as knot embroidery, circle stitch, or jade embroidery. As shown in Figure 10, in the knot stitch, after bringing the needle up through the fabric, the embroidery thread is looped around the needle to form a circle. The loop is held in place with a finger, and then the needle is pulled down, tightening the thread to create a small, circular knot. These knots are arranged in patterns to create a textured and decorative effect.

There are various forms of the knot stitch with different stitching techniques. The knots can be either hollow knots or tadpole knots, and the size and shape of the knots depend on the number of times the thread is looped around the needle and the tightness with which the knot is secured.

For the knot stitch, consistency in the appearance and size of each knot is essential on the same piece of embroidery. The arrangement of knots should be even and orderly, and the colors should transition naturally. Creating a piece of the knot stitch can be a time-consuming process. In terms of composition, the knot stitch can be categorized as either full ground or exposed ground. When the knot stitch is the main stitching technique covering the entire design, it is often complemented by techniques such as coiled gold embroidery or twisted thread embroidery to depict the outer contours. As shown in Figure 11 that is from Peranakan Museum in Singapore, the advantages of knot stitch embroidery are its durability, wear resistance, strong three-dimensional sense, and rich texture. It is often used to portray the texture and stamen of objects, as well as independently embroider patterns of flowers, animals, figures.



Figure 10. The knot stitch



Figure 11. Mirror cover

Couched Stitch

It is clear from Figure 12 that the technique of couched stitch involves securing a thread or fine cord onto fabric and then wrapping it with another thread, ultimately creating a decorative edge effect. This embroidery method is often used to add additional embellishments to the edges or specific areas of fabric, enhancing the overall aesthetics. It can also be applied in embroidery projects to create lace, borders, or other intricate patterns. Lace embroidery can utilize different types of threads and colors, providing a rich layering and variation along the edges to meet various design requirements.

The coiled gold embroidery is a type of couched stitch, distinguished from other embroidery techniques by the use of gold threads (Jones, L., & Nabil, S. 2022), as shown in Figure 13. The key difference lies in the use of gold threads that are wound around and secured horizontally with silk threads, giving it the alternate name nail embroidery. In the process of creating coiled gold embroidery, the embroiderer carefully lays two gold threads side by side along the pattern, flattens them, and then begins stitching. Using threads of a color close to the gold, the embroiderer tightly secures the two gold threads onto the pattern. The gold threads twist and turn along the changing pattern, and the embroiderer ensures their secure placement, giving rise to the name coiled gold embroidery. Gold threads can be used to outline the edges of the pattern or fill the entire pattern, creating a luxurious and ornate effect. The embroiderer must carefully estimate the length of gold thread required for each pattern. As the two gold threads need to be continuously wound throughout the embroidery of a pattern, without breaking or changing threads midway, it requires skill and precision; otherwise, the work may be interrupted, and even

the most skilled embroiderer cannot rectify it. The coiled gold embroidery has its origins in the Chinese imperial court, and it carries a sense of royal craftsmanship.



Figure 12. The Couched Stitch

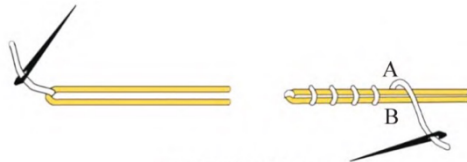


Figure 13. The coiled gold embroidery

Coiled gold embroidery is an important form of Baba-Nyonya's embroidery, typically used to decorate traditional clothing of the Baba Nyonya such as wedding robe and wedding skirt, as shown in Figure 14 that is from Baba&Nyonya Heritage Museum. Additionally, it is commonly found in accessories such as handbags, headpieces, necklaces, as well as homeware like cushions, curtains and drapery, as shown in Figure 15 that is from Pinang Peranakan Mansio. Coiled gold embroidery showcases the unique aesthetics and exquisite craftsmanship of Baba Nyonya culture. It is not only a part of clothing and accessories but also a vibrant expression of the traditions within Baba Nyonya culture.



Figure 14. Wedding skirt



Figure 15. Embroidery drapery

Bead embroidery

Bead embroidery refers to a technique in which beads are used for decoration during the embroidery process. In this embroidery method, the craftsmanship of embroidery is combined with bead embellishments. Beads are secured onto the fabric using needle and thread, imparting a unique brilliance and texture to the embroidery. The primary materials used in Baba-Nyonya's bead embroidery include various types of beads, such as glass beads, crystal beads, plastic beads, and more. These beads were typically imported from countries such as Indonesia, Europe, the Middle East, etc. BaBa Nyonyas combined beads of different colors and sizes to create a rich and colorful effect, as shown in Figure 16 that is from Peranakan Museum in Singapore. The diverse sources of materials for BaBa Nyonya bead embroidery reflect the exchange and fusion of local culture with external cultures.

In bead embroidery, precision in manipulating the needle and thread is crucial to systematically embed beads into the fabric, forming beautiful patterns. Additionally, the embroidery thread plays a vital role in securing the beads onto the fabric. Baba-Nyonya's bead embroidery is widely

used in the creation of garments, accessories, and home decor items, as shown in Figure 17 that is from Pinang Peranakan Mansion. Traditionally, it has been a common choice for embellishing wedding attire and special occasion outfits, showcasing its high level of artistry and intricacy.



Figure 16. The bead embroidery collar

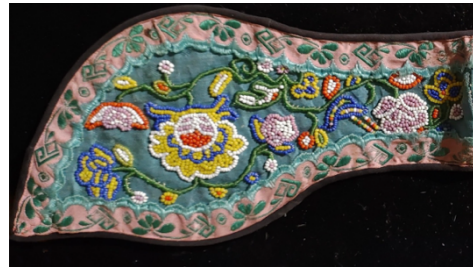


Figure 17. Bead embroidery of Woman's head band

5. Discussion and conclusion

In the late 19th-early 20th century, BaBa-Nyonya's embroidery in Malacca, Penang and Singapore was commonly used in traditional apparel such as wedding robe, wedding skirt and Kebaya. It was also applied to various accessories including handkerchiefs, collars, belts, shoes, bags, spectacle cases, etc. BaBa-Nyonya's embroidery was frequently used in houseware such as bed curtains, altar tablecloths, mirror covers, pillowcases, etc., adding an artistic and cultural ambiance to the household environment and festive celebrations (Cheah, 2017). These embroidered works were used as significant decorative elements in special occasions like weddings and celebrations.

The stitch techniques of the embroidery used on traditional apparel, accessories, and housewares are diverse, contributing to a three-dimensional and layered effect in BaBa-Nyonya's embroidery. Among the seven stitch techniques of Nyonya embroidery mentioned above, satin stitch, long and short stitch, and back stitch are the three most basic embroidery stitches. The four embroidery stitch techniques such as satin stitch, knot stitch, couched stitch and bead embroidery are used frequently. The two most distinctive Nyonya embroidery stitches are coiled gold embroidery and bead embroidery.

Coiled gold embroidery has its origins in the ancient Chinese imperial court, using gold and silver threads to create exceptionally ornate embroidered pieces. It is mainly used to decorate Nyonya wedding robe, wedding jacket and wedding skirt. Additionally, coiled gold embroidery is also found in accessories and homeware, such as handbags, headpieces, necklaces, cushions, curtains and drapery. Bead embroidery incorporates beads from various countries, it imparts a unique shine to the embroidery when combined with threads and fabrics.

From the stitch techniques of Baba-Nyonya's embroidery, it is evident that Peranakan embroidery possesses distinct cultural characteristics. It is a product of cultural fusion, blending elements from the local Malay culture, Chinese culture, Western culture, and other cultural influences (Seri, 2012). This showcases the unique beauty of the local multicultural heritage. The stitch techniques of Baba-Nyonya's embroidery continue to hold a significant position today, serving as part of cultural heritage and the ongoing legacy of craftsmanship.

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Authors Contributions

Chen XiuMian : Responsible for the research, and the main author who responsible for the reliability of the article.

Rose Dahlina Rusli : Guidance on research and article revision.

Rohana Binti Zur : Suggestion for revising the article.

Kang Sujuan : Contributed indirectly to the research, providing indirect research suggestion on data collection and the topic.

Conflict of Interest

No conflict of interest indicate in this article.

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ANALYSING THE SUSTAINABILITY OF AN ART CAREER FROM THE CAREGIVERS' EXPERIENCES AND PERSPECTIVE FOR AUTISTIC INDIVIDUALS

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ABSTRACT

This study examines the sustainability of art careers for autistic individuals by exploring the experiences and perspectives of caregivers, shedding light on the challenges and opportunities within this unique career path. Utilising a qualitative methodology, the research involved thematic analysis of interviews and observations, categorised into nine themes: Early Interest and Skill Development in Art, Art as a Means of Communication and Expression, Sensory Issues and Adaptations in Art, Techniques and Mediums in Art, Autonomy in Artistic Decisions, Participation in Art Activities and Programs, Exploration of Other Art Forms and Interests, Marketing and Support for Artistic Endeavours, and Benefits of Art for Well-being. Findings indicate that early interest in art leads to skill development and emotional expression, art facilitates non-verbal communication and specific adaptations are necessary to address sensory issues. The study also reveals that while art enhances autonomy and well-being, limited access and support often hinder participation in art activities. The implications suggest that enhancing support systems and opportunities for autistic individuals in the arts can significantly improve their quality of life and provide viable career paths. However, the study is limited by its

qualitative nature and the small sample size, which may affect the generalizability of the findings.

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1. Introduction

In a world increasingly driven by technology and innovation, the inclusion and empowerment of neurodiverse individuals have become paramount. Autism Spectrum Disorder (ASD) affects millions globally, presenting unique challenges in communication, social interaction, and employment. A study conducted by Johnson et al. (2016) and supported by Harmuth et al. (2018) implied that the worldwide low job rates could be associated with personal and environmental influences. Based on a review by Hayward et al. (2018) and Lallukka T. et al. (2020), despite significant strides in understanding and support, autistic individuals often face barriers to sustainable careers. According to a 2024 scoping review, many autistic people strongly desire career progression. Still, they are usually underemployed or stuck in jobs that do not match their skills and qualifications. The review highlighted by Davies et al. (2024) that about 85% of autistic adults are unemployed or underemployed, which is a significantly higher rate than the general population. Furthermore, a discussion conducted by Nicholas et al. (2019) on employment in autism revealed that barriers such as a lack of understanding in the workplace, insufficient job accommodations, and underutilisation of available funding streams contribute to these employment challenges. These statistics underscore the need for tailored support and inclusive employment practices to help autistic individuals achieve sustainable careers.

Art offers a valuable way to overcome employment barriers for autistic individuals. Creative expression promotes communication and self-advocacy, paving the way for fulfilling careers. Bowles (2024) highlighted studies showing art's transformative potential in fostering career paths for this community. While about 85% of autistic adults face unemployment or underemployment (Golden Steps ABA, 2024), art provides an alternative pathway, enhancing emotional well-being and social skills. Programs focused on art therapy improve cognitive and social functioning, making autistic individuals more adaptable in various professional settings (Hofmann, 2024). Art-related careers can be tailored to individual strengths, creating more inclusive work environments.

In Malaysia, the unemployment rate among individuals with autism is a significant concern. In 2022, there were 674,548 persons with disabilities, including many with autism, as reported by the Department of Statistics Malaysia (Chandran, 2024). Despite initiatives to increase job opportunities, autistic individuals face substantial barriers to securing and maintaining employment. Research by Ghuzal et al. (2023) highlighted the lack of legislation for transition services for students with special needs. The Malaysian Plan of Action for People with Disabilities (2016-2022) aims to improve employment support services and training for better job transitions. A study by Vanessa et al. (2023) asserted the reduced employment opportunities for those with ASD, stressing the need for more inclusive hiring practices. Additionally, only 22% of autistic adults are employed, reflecting a troubling global trend of high unemployment in this population. This disparity between autistic individuals and the general workforce underscores the need for targeted interventions and systemic changes to enhance employment opportunities.

System Analysis Program Development (SAP)'s Autism at Work initiative demonstrates that matching job functions to the strengths of autistic individuals and offering customized assistance can result in positive employment results (Austin et al., 2017). SAP announced that the initiative enhanced team dynamics and boosted overall productivity, highlighting the advantages of

neurodiversity in the workplace. This program has motivated other organizations, such as Microsoft and JPMorgan Chase, to adopt comparable initiatives. Malaysia might find advantages in implementing comparable models and policies aimed at fostering a more inclusive workforce for individuals with autism. This highlights the necessity for tailored accommodations, training, and support systems that are vital for their effective integration into the job market.

Research consistently highlights the significant issue of underemployment among autistic individuals. For instance, Chen (2015) demonstrated that many autistic adults are employed in positions that do not align with their qualifications or skills, often resulting in inadequate pay and job dissatisfaction. This issue is intensified by findings from Griffiths et al. (2020), which suggested that employers frequently underestimate the abilities of autistic job candidates, further contributing to their underemployment. Recent studies continue to shed light on these challenges. Davies et al. (2024) emphasised that many autistic adults are actively seeking research and initiatives aimed at improving their employment conditions and opportunities, reflecting their ongoing struggles with underemployment. Similarly, Zhou et al. (2024) highlighted the persistently high unemployment rates among autistic individuals, illustrating the systemic barriers they encounter in the job market. These studies underscore the urgent need for more inclusive employment practices and workplace environments that can fully leverage the skills and talents of autistic individuals.

An area of significant research gap is the exploration of self-employment as a viable alternative to traditional employment for autistic individuals. Szaban et al. (2018) predominantly focused on integrating autistic individuals into conventional work environments, often overlooking the potential benefits of self-employment and entrepreneurship. This gap highlights the need for research into how autistic individuals can utilize their unique skills and interests to pursue self-employment, particularly in creative fields such as the arts. Exploring self-employment in the arts offers potential advantages, such as flexible schedules and tailored work environments, which can be more accommodating for autistic individuals. According to studies by Bennie (2016) and Islam (2020), self-employment in the arts allows autistic individuals to harness their creativity and transform it into a profitable venture. This approach can lead to greater economic independence and job satisfaction, providing a promising avenue for addressing this population's persistent challenges of underemployment and unemployment.

This paper explores art as a sustainable career path for autistic individuals from a caregiver's perspective. The introduction discusses the challenges autistic individuals face in traditional jobs and presents art as a viable alternative. The literature review covers research by Jeong et al. (2021), Hofmann (2024), and Vicente (2023), highlighting art's therapeutic and professional benefits. The methodology section outlines the qualitative approach, involving interviews with caregivers to assess the impact of art-based careers on well-being and as career starters. By examining case studies, the study provides insights into the financial and emotional benefits of art careers for autistic individuals, supporting findings from Spiro et al. (2023). The results and discussion, informed by Hollander (2023), share case study findings on the successes and challenges autistic artists face in their careers. Finally, the conclusion emphasizes the need to support autistic individuals in artistic careers for financial independence and personal growth, offering recommendations for future research and inclusive policies.

2. Literature Review

Understanding the unemployment challenges faced by autistic individuals begins with recognizing ASD, a neurodevelopmental disorder that affects communication, social skills, and behaviour, impacting about 1 in 54 children in the U.S. (U.S. Centers for Disease Control and

Prevention; CDC, 2020). In Malaysia, awareness of the strengths of autistic individuals is growing, and support groups are helping parents (Chu et al., 2018).

Autistic individuals often struggle with social interaction and communication, making employment difficult due to differences in communication styles with neurotypicals. Research highlights their challenges in interpreting social cues and nonverbal communication (Ara et al., 2024; Andari et al., 2010). Those with Level 1 autism may find it hard to initiate social interactions and understand expectations (Round et al., 2017; American Psychiatric Association, 2013). These barriers can lead to isolation and an increased risk of depression (Attwood, 2013). The unemployment rate for autistic individuals is high due to these challenges (Halid et al., 2020). Art therapy has been demonstrated to help children on the spectrum cope with their challenges, aligning with their preferred learning styles and helping to build positive relationships (Round et al., 2017; Evans et al., 2001).

Empirical research underscores the efficacy of art interventions for children with ASD. For instance, Allison et al. (2022) demonstrated that art interventions significantly enhance occupational therapy outcomes, thereby improving both functional abilities and overall well-being. Similarly, Schweizer et al. (2014) observed that art therapy fosters improvements in social communication, flexibility, and attention in children with ASD, owing to its structured yet adaptable nature. Durrani (2019) argued that art therapy effectively addresses core ASD symptoms by facilitating sensory regulation, psychomotor development, and communication. Roth (2020) emphasized the necessity of a nuanced understanding of creativity in autism to fully appreciate the distinctive artistic expressions of autistic individuals. Furthermore, Emery (2004) highlighted art therapy's substantial impact on child development, particularly in enhancing object constancy through drawing.

Recent studies continue to emphasize the role of art in advancing cognitive and behavioural development among autistic individuals. Ji (2023) demonstrated that art appreciation alleviates cognitive barriers and supports multidisciplinary treatment approaches. Sampurno et al. (2020) discovered that combining art therapy with play and empathy enhances communication skills, advocating for a flexible and natural learning environment. Wright (2023) extended these benefits to autistic adults, noting improved communication and emotional regulation. Martin (2009) reviewed the unique advantages of art therapy despite prevailing challenges. Sampurno (2019) revealed that conceptualizing therapeutic processes as performing art can enhance communication, memory skills, and confidence in autistic children and their families. Collectively, these findings highlight art's extensive impact across different developmental stages and its potential to support cognitive and emotional growth.

The growing trend of self-employment in artistic fields such as design, writing, and photography offers a promising solution to unemployment among autistic individuals (Woronkowicz et al., 2017). Agrawal et al. (2010) documented the alignment of artistic pursuits with entrepreneurial endeavours, while Berkell (1987) emphasized the need for career development programs tailored to individuals with disabilities, including autism. Nagib et al. (2020) advocated for autism-specific career-matching tools and enhanced self-employment support.

Freelancing is prevalent among artists, who frequently alternate between self-employment and traditional roles. Artists in high-density artistic communities are likelier to engage in self-employment (Woronkowicz et al., 2019). However, traditional workplaces can present significant challenges, leading to lower self-efficacy and well-being among autistic individuals (Buckley et al., 2021). The Integrated Model for Self-Structuring Portfolio Professions by Wyszomirski and Chang illustrates how creative workers sustain their careers by managing diverse income sources and work practices (Wyszomirski et al., 2017). Jeong et al. (2017) also reported that job satisfaction influences

entrepreneurial intentions, suggesting that self-employment may be a viable alternative for those facing challenges in conventional employment settings.

The connection between art and autism has gained significant interest from researchers. Creative expression can provide unique opportunities for autistic individuals. As careers evolve, especially in the arts, it is crucial to develop and maintain a resilient and flexible career identity. Ashforth et al. (2001) theory regarding the formation of adaptive career identity, as referenced by Bridgstock (2013), offers a convincing framework for comprehending how experiential learning in arts entrepreneurship can enhance this adaptability. According to this theory, career identity is an evolving concept rather than a fixed trait moulded by participation in significant experiences that resonate with a person's values and goals.

3. Methodology

The methodology for this paper was designed to explore the role of art in providing career opportunities for autistic individuals in Malaysia as a preliminary research study. The research adopted a qualitative design to gain in-depth insights into the experiences and perspectives of caregivers of autistic individuals. This approach was suitable for understanding complex, context-specific phenomena that could not easily be quantified. The population for this study consisted of caregivers of autistic individuals in Malaysia. A sample size of three caregivers was selected using purposive sampling. Purposive sampling was selected as it offers the most relevant and comprehensive insights, ensuring the gathering of the most valuable information possible (Han et al., 2021). The three caregivers were selected as key informants based on three criteria: (1) their experience, (2) their familiarity with the topic, and (3) the diversity of their contexts. This sampling method was effective in selecting participants who possessed pertinent experience, enabling them to offer comprehensive, detailed, and varied insights regarding the research questions. These caregivers possess first-hand experience in autism care, having worked directly with individuals on the spectrum. They are actively engaged in their communities, demonstrating a commitment to support and advocacy. Their diverse backgrounds and rich array of contextual experiences contribute to a well-rounded perspective, forming a robust foundation for their selection as exemplary caregivers. To support the decision to select three caregivers through purposive sampling, the principle of data saturation was crucial. This approach ensures that collecting further data yields no additional insights or themes, reinforcing the adequacy of the chosen participants.

In this study, a modest sample size proves adequate, as data saturation was accomplished with participants offering rich, detailed, and varied insights on the subject matter. Saunders et al. (2018) highlighted the significance of data saturation over participant count, arguing that even a small group, like these three caregivers, can be valuable if no new themes or insights arise. This underscores the depth of understanding that can be achieved with focused, qualitative analysis. Data collection involved face-to-face, semi-structured interviews, allowing flexibility to probe deeper into relevant topics while maintaining a structured set of questions. This approach captured the complexity of the caregivers' experiences and perceptions. The interview data was analyzed using Atlas.ti 24 software. Transcribed audio recordings were coded to identify key statements and themes, which were then grouped through thematic analysis. This method highlighted how art can provide career pathways for autistic individuals, adding to the existing literature on autism, art therapy, and career development.

4. Results

In this paper, a qualitative preliminary study was undertaken to investigate the impact of art on the lives of individuals with autism, uncovering several significant themes. These are the key findings from the preliminary study interview transcript with caregivers of autistic

individuals. Accordingly, nine themes were identified from the interview transcripts for further discussion.

Table 1

Overview of the Coding and Thematic Analysis of the Preliminary Interview Study Transcripts

Theme	Codes
Theme 1: Early Interest and Skill Development in Art	Early interest, painting skills, doodling practice, daily drawing, evolving interest.
Theme 2: Art as a Means of Communication and Expression	Non-verbal communication, emotional expression, use of colours, and requests for sketchbooks.
Theme 3: Sensory Issues and Adaptations in Art	Sensory issues, motor skills, sensory overload adaptations, and coping strategies.
Theme 4: Techniques and Mediums in Art	Tool preferences, challenges with mediums, doodling vs. painting, and structured art practices.
Theme 5: Autonomy in Artistic Decisions	Independent artistic choices, mood-based themes, storytelling, and inspiration from surroundings.
Theme 6: Participation in Art Activities and Programs	Volunteering in school mural programs, social media resources, exhibition participation, and teacher support.
Theme 7: Exploration of Other Art Forms and Interests	Lego, music interest, paper art, building blocks activities.
Theme 8: Marketing and Support for Artistic Endeavours	Social media promotion, limited marketing, teacher support, exhibition sales, and financial motivations.
Theme 9: Benefits of Art for Well-being	Time engagement, emotional regulation, stimming effect, self-expression.

Upon thoroughly examining the code, the identified themes have elucidated the potential for establishing a viable art career for individuals with autism through the experience with the caregivers. It presented quotes from participants advising on discovering artistic talents and cultivating the potential for a successful art career; these ideas can be implemented.

Table 2

Theme 1: Early Interest and Skill Development in Art

Codes	Contexts
Initial Exposure and Evolution of Interest	- Early interest began with simple activities like drawing, which gradually deepened.
	- Participant C started with basic drawing and began to enjoy it.
	- Participant B was introduced to art through small motor skill tasks like doodling, which sparked her interest.

Drawing and Painting Preferences	- Participants developed specific material preferences.
	- Participant B preferred pencils for easy correction.
	- Participant C used pencils and watercolours.
	- Participant A preferred brushes and earth tones and avoided finger painting due to sensory sensitivities.
Early Interest in Art and Painting	- Caregivers observed that participants started engaging with art at a young age, as early as four years old for Participant B, which provided a foundation for skill development and personal expression.
	Art helped participants to express emotions, emphasizing its role in self-expression and emotional regulation.
Daily Art Practice and Skill Development	- Participants practised art daily, showing dedication.
	- Participant B requested paper and sketchbooks for daily drawing, indicating genuine solid motivation.
	- Participant C explored themes like seasons and personal experiences through regular practice.
Art as a Medium for Emotional Expression	- Art provided an outlet for managing emotions.
	- Participant A found painting therapeutic and could spend long periods on it.
	- Caregivers noted that art supported emotional expression and self-regulation.

The early interest and skill development theme highlights the journey of autistic individuals from initial exposure to deeper engagement with art. Caregivers noted that simple drawing exercises evolved into preferred mediums, leading to emotional expression and self-regulation. This foundational involvement not only enhanced their skills but also laid the groundwork for a sustainable art career in the future.

Table 3
Theme 2: Art as a Means of Communication and Expression

Codes	Contexts
Art as a Means of Self-Expression	- Art provided a crucial outlet for self-expression that was hard to communicate verbally.
	- Participant B used drawing as a "stimming" activity to calm herself at school.
Expressing Mood and Feelings through Art	- Participants conveyed moods and emotions through art.
	- Participant C expressed perceptions and emotions through drawing.
	- Non-verbal Participant A used colours and shapes to convey his inner experiences.
Non-verbal Communication through Art	- Art served as a primary communication tool for non-verbal individuals like Participant A.
	- Participant A used shapes and letters to communicate his thoughts and emotions non-verbally, allowing caregivers to gain insights into his inner world.
Use of Imagination in Art	- Participants displayed creativity and storytelling through art.
	- Participant B's drawings told stories.

	- Participant C incorporated Lego designs, showing personal ideas and creativity.
Use of Earth Colours Based on Emotions	- Participant A preferred earth tones to express emotions and feel grounded. - Earthy colours helped him manage emotions better through art.
Requests for Sketchbooks	- Participant B requested sketchbooks to self-regulate during overwhelming times. - Daily use of sketchbooks helped her manage stress, especially in school.

Theme 2 highlights that art is crucial for the emotional well-being, self-expression, and communication of autistic individuals. It allows them to convey their inner experiences, especially for non-verbal participants like A. For others, like B, art serves as a coping mechanism and a means to tell their stories. Caregivers note improvements in communication skills and therapeutic benefits through art, underscoring its value as an ongoing activity.

Table 4
Theme 3: Sensory Issues and Adaptations in Art

Codes	Contexts
Fine Motor Skill Difficulties	- Participant B faced challenges in holding small tools like pencils and brushes due to fine motor skill limitations. - Participant A also struggled with fine motor tasks, requiring ongoing skill-building tasks like doodling or cutting to improve control and coordination.
Sensory Overload and Training to Handle Tools	- Participant A experienced sensory overload when handling some art tools, needing the training to handle them comfortably. - Adaptive techniques helped Participant A gradually increase tolerance and engage in art.
Challenges with Watercolour	- Participant B found the watercolour work tiring and challenging due to the sustained focus and energy required. - Participant B required support and needed to slow pacing and breaks to manage this medium effectively.
Sensory Issues with Painting on Hands	- Participant A avoided painting with his fingers, preferring brushes to avoid direct contact with the paint, reducing sensory discomfort and enabling him to participate more in painting activities.
Frequent Hand Washing Due to Sensory Issues	- Participant A frequently washed his hands when encountering uncomfortable textures, helping him to manage sensory discomfort and continue with art.
Coping with Sensory Overload at School	- Participant B used her sketchbook for self-soothing during sensory overload at school, which helped her handle sensory challenges in other environments as well.

The third theme examines the sensory challenges faced by autistic individuals in art, such as fine motor difficulties, sensory overload, and specific aversions to textures. Caregivers employed adaptive methods to help build skills, limit uncomfortable contact, and implement coping

strategies like hand washing. Accommodations, including tool adaptations and sensory breaks, allowed participants to engage more in artistic practices.

Table 5
Theme 4: Techniques and Mediums in Art

Codes	Contexts
Painting with Brushes and Watercolours	- Participant A demonstrated skill in blending colours with brushes, which they found calming.
	- Participant C used brushes and watercolours, exploring themes like seasons and inspiration from movies and travel.
	- Participant B found watercolours challenging and required additional support.
Skills in Painting and Blending with Brushes	-Participant A developed skills in blending techniques with support from caregivers and teachers.
	- Teachers guided skill expansion, leading Participant A to volunteer for a school mural, enhancing his sense of inclusion.
Preference for Using Brushes	- Due to sensory discomfort, Participant A preferred brushes over finger painting, allowing a more comfortable and enjoyable painting experience.
Doodling with a Pen	- Participant B enjoyed doodling with a pen, offering a spontaneous and different creative outlet compared to painting.
Preference for Drawing with Pencils over Pens	- Participant B preferred pencils for easy corrections, giving her control and flexibility and boosting her confidence in art.

The fourth theme explores the techniques and preferences in the artistic practices of autistic individuals, focusing on how tools and sensory needs influence their art experiences. Participants exhibited unique inclinations for various mediums, such as brushes and watercolours, with painting offering both challenges and therapeutic benefits. Caregivers emphasized the importance of guidance in skill development. Sensory-friendly tools, like brushes, helped those with sensitivities engage comfortably, while pencils provided control and adaptability, fostering self-confidence. These insights underscore the need for diverse mediums to make art accessible for autistic individuals.

Table 6
Theme 5: Autonomy in Artistic Decisions

Codes	Contexts
Drawing Based on Surroundings and Activities	- Participants found inspiration in daily life, such as friends, activities and travel.
	- Participant C explored seasonal themes, especially winter, reflecting a preferable connection between his imagination and artistic expression.
Drawing Based on Mood and Perception	- Art reflected participants' emotions.
	- Participant C created art based on mood.
	- Participant A used earth tones to express personal feelings and self-expression.

Drawing without External Influence	- Caregivers let participants choose their art themes, encouraging self-expression and building confidence.
Storytelling through Art	- Art served as a storytelling medium.
	- Participant B drawings narrated unique tales. - For non-verbal, Participant A used art to convey emotions and ideas.
Replicating Based on Perception and Feelings	- Participants replicated scenes they faced with personal interpretations.
	- Participant C drew based on his feelings and observations. - Non-verbal Participant A created animal-like shapes or word art, combining external inspiration with personal meaning.
Inspiration from Movies and Travel	- Exposure to diverse experiences like movies and travel expanded creativity.
	- Participant C included themes from these experiences in his artwork.
	- Participant B drew scenes from her travels, showing experiences fostered autonomous exploration in artworks.

Theme 5 emphasizes the significance of autonomy in the artistic choices of autistic individuals. It showcases their ability to independently decide what and how to create, drawing inspiration from their surroundings and experiences. Caregivers adopted a non-interventionist approach, allowing for free exploration of creativity. This independence fostered confidence and ownership over their artistic processes, providing a meaningful way to express and communicate their emotions and experiences.

Table 7
Theme 6: Participation in Art Activities and Programs

Codes	Contexts
Doodling and Drawing Practice	- Initial doodling and drawing activities introduced participants to art.
	- Participant B began with small motor skill tasks like doodling and cutting, which sparked her interest.
	- Participant C's simple drawings evolved into a meaningful practice.
	- Caregivers used social media platforms like Facebook and Instagram to find autism-friendly art resources and connect with potential buyers for participants' artwork.
	- The caregiver encounters problems with limited marketing exposure.
Volunteering in School Mural Programs	- School programs allowed participants, like Participant A, to paint murals and share their talents.
	- Participant C's caregiver noted that schools lack specialized art programs for autistic individuals, limiting their exposure and skill development.
Participation in Art Classes and Exhibitions	- Art classes and exhibitions helped participants improve their skills and gain recognition.
	- Participants entered an art exhibition where their paintings were sold.

	- Teachers connected participants with exhibition opportunities.
Attending Art Classes	- Structured classes offered guidance and skill-building in techniques like watercolour, which benefited participants like B and C.
Lack of Art Activities for Special Needs	- Caregivers noted a lack of inclusive art programs for autistic individuals, making it challenging to find suitable resources like music tutors and highlighting broader gaps in resources for autistic individuals.

Theme 6 highlights the role of structured art programs and community support in engaging autistic individuals in art. Participants grew through organized activities, while social media helped caregivers share resources and artwork. Despite this, caregivers noted a lack of resources and called for more inclusive programs to support artistic potential.

Table 8
Theme 7: Exploration of Other Art Forms and Interests

Codes	Contexts
Interest in Building Blocks	- Building blocks like Lego provided a creative outlet.
	- Participant C enjoyed experimenting with designs.
	- Participant A used Lego to explore shapes without instructions freely.
	- Participant B had an interest in Lego, highlighting its broad appeal.
Interest in Music	- Music was a key interest for Participant D, who could follow and recite notes.
	- This interest added sensory and cognitive engagement, complementing art.
Creating Shapes and Word Art from Tearing Papers	- Participant A tore paper to create shapes and words, combining sensory enjoyment with fine motor and spatial skill development.
Building with Building Blocks	- Building blocks enabled imaginative and autonomous play.
	- Participant A enjoyed creating various shapes and structures, aligning with a preference for structured, repetitive and hands-on activities.

Theme 7 highlights the diverse creative and sensory interests beyond traditional visual art, showcasing the importance of multi-sensory engagement in autistic individuals. Activities like building blocks foster tactile creativity and spatial understanding, while music enhances auditory engagement and memory skills. In particular, paper tearing combines sensory and fine motor skills, reflecting preferences for both deconstructive and constructive play. These varied interests underscore the need for a broad range of art and sensory activities to support the creative development of autistic individuals.

Table 9
Theme 8: Marketing and Support for Artistic Endeavours

Codes	Contexts
Social Media to Promote Artwork	<ul style="list-style-type: none"> - Caregivers used platforms like Instagram to showcase, promote and market participants' artwork and used the platform for greater visibility. - Participants' caregivers managed promotions despite limited reach.
Sales and Commissions through Social Media	<ul style="list-style-type: none"> - Social media facilitated actual sales and commissions for participants. - Participants received custom orders through social media. - This demonstrated the potential of social media as a marketplace for autistic individuals' artwork.
Selling Artworks at Exhibition	<ul style="list-style-type: none"> - Exhibitions provided public display and sales opportunities. - Participant C sold paintings at an exhibition, and Participant B's teacher promoted her work. - These events validated the participants' artistic achievements.
Motivation to Create Financial Rewards	<ul style="list-style-type: none"> - Financial rewards motivated participants to create more art. - Participant C linked art sales to buying toys, boosting his motivation.
Support from Teachers in Promoting Art	<ul style="list-style-type: none"> - Teachers and autistic committees played an instrumental role in promoting participants' artistic work. - Teacher support encouraged participants with exhibition opportunities, enhancing their reach.
Upcoming Exhibition Participation	<ul style="list-style-type: none"> - Ongoing exhibitions provided future opportunities. - Participant C is scheduled to participate in another exhibition, reflecting growing public engagement.
Limited Marketing Exposure	<ul style="list-style-type: none"> - Caregivers faced marketing challenges due to limited time and resources. - Participant A's social media presence was constrained by caregiver availability.

Theme 8 emphasizes the importance of social media, exhibitions, financial incentives, teacher support, and autistic committees in promoting the artistic endeavours of autistic individuals. Social media (Instagram and Facebook) boosted visibility and sales, while exhibitions offered public recognition and financial rewards that motivated continued creation. Teachers in the autistic committee helped connect artists with promotional opportunities, and financial incentives linked their artwork to tangible benefits, highlighting the advocacy role of teachers in promoting autistic artists' work. However, limited marketing exposure due to time and resource constraints remained a challenge, highlighting the need for ongoing, additional support to enhance the reach and visibility of autistic artists.

Table 10
Theme 9: Benefits of Art for Well-being

Codes	Contexts
Occupying Time	- Art provided a constructive way to occupy time meaningfully.
	- Participant C engaged in drawing and Lego, while Participant A spent his time painting and building with Lego.
	- Art activities reduced boredom and promoted a sense of self-fulfilment.
Calming (Stimming) Effect of Art from Drawing	- Art, especially drawing, helped manage sensory overload and emotional regulation.
	- Participant B used drawing as "stimming" to calm herself, especially in challenging environments like school, providing a safe method for self-regulation.
	- Painting helped Participant A maintain calm, balance and tranquillity.

The final theme highlights the dual benefits of art for autistic individuals. Art activities like drawing, painting, and building with Lego not only engage participants constructively but also provide a calming effect that helps manage sensory overload and emotional challenges. These creative outlets foster a sense of accomplishment while offering therapeutic benefits, aiding in emotional regulation and enhancing well-being. Overall, art serves as a valuable, non-verbal tool for autistic individuals to navigate their daily lives with greater comfort and confidence.

Word frequency clouds, also called word clouds or text visualizations, are graphical depictions that showcase the frequency of words within a specific body of text. The tool can provide instant insights into the dominant themes and topics discussed by participants through qualitative data analysis, like the interview data depicted in the word frequency cloud provided. Below are the Word Frequencies Cloud generated by Atlas.ti 24 from the analysis results.

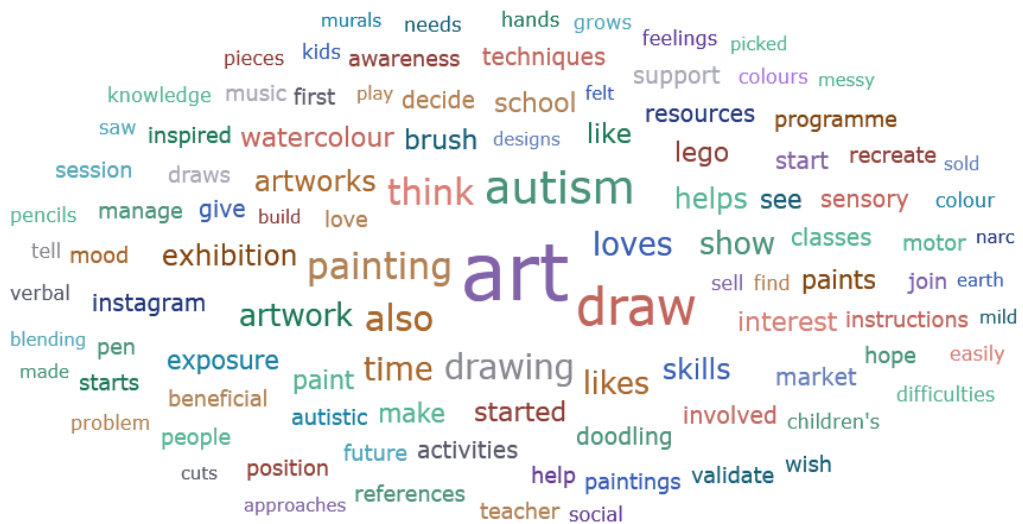


Figure 1. Preliminary Study Data Collection in Word Frequencies Cloud

The word frequency cloud above emphasizes various important terms connected to an art show and its apparent influence on people with autism.

The word frequency cloud highlights key themes with prominent words like "art," "draw," "autism," and "painting," underscoring art's importance for autistic individuals. This suggests that art is more than a hobby; it is a vital means of expression, development, and connection. Terms like "display," "talents," "affection," and "assistance" indicate the exhibit's role in showcasing autistic individuals' abilities, fostering a passion for art, and providing support, contributing to their personal and social growth.

The cloud also demonstrates a variety of art-related activities, with words like "drawing," "watercolour," "Lego," "brush," and "pencils," reflecting participants' diverse artistic interests and methods. The mention of "classes" implies that structured learning environments play a crucial role in helping participants build skills through guided artistic exploration.

Emotionally and socially, terms like "helps," "support," "inspired," "love," and "awareness" reflect art's role in enhancing well-being and social interaction. Art serves as a therapeutic outlet, allowing autistic individuals to express emotions, develop social skills, and connect with the community, thereby improving their quality of life.

Finally, words like "difficulties," "manage," "needs," and "problem" highlight challenges faced by autistic individuals in engaging with art, emphasizing the need for tailored support. "Sensory" underscores the significance of addressing sensory sensitivities, which often affect how they experience and participate in art, requiring specific accommodations to fully benefit from artistic expression.

5. Discussion

This study reinforces the positive influence of art on autistic individuals by highlighting how early engagement, autonomy, and structured programs foster essential skills and well-being. Each theme underscores the therapeutic and developmental benefits of art, aligning with previous literature on art's role in supporting cognitive and emotional growth (Schweizer et al., 2020; Rojas-Torres et al., 2020).

Early exposure to art helped develop fine motor skills and provided participants with a foundation for skill progression. This theme aligns with research emphasizing the importance of early exposure to creative activities in skill acquisition (Rojas-Torres et al., 2020). Similar to theories on skill acquisition, repetitive, structured activities in art allowed for both cognitive and motor development (Mayer-Benarous et al., 2021).

Art also served as a non-verbal communication tool, crucial for those with limited verbal abilities. This aligns with findings by Sutarjo (2023), who suggested that art offers a bridge for non-verbal autistic individuals, allowing them to share emotions and stories through visual expression; like Participant A, art became a vital means of expressing emotions and connecting with others, underscoring art's role as a communicative bridge.

Sensory sensitivity was a common challenge, but adaptive strategies like specific tools and sensory breaks enabled participants to engage in art more comfortably. This supports sensory integration theories that advocate for customized environments to improve engagement (Morgan, 2019). These adaptations underscore the need for individualized approaches in art programs to cater to diverse sensory profiles among autistic individuals (Schweizer et al., 2020).

Distinct techniques and preferences for mediums, such as brushes and colours, allowed participants to express emotions while managing sensory needs. The choice of colours and tools aligned with personal preferences and sensory comfort has been shown to support both skill development and emotional resilience (Rojas-Torres et al., 2020). This suggests that colour choice may serve as an additional layer of emotional expression for autistic individuals (Schweizer et al., 2020).

Autonomy in artistic choices was significant, as caregivers encouraged independent decision-making, which aligns with self-determination theory (Grove et al., 2018). The freedom to choose art subjects helped participants build confidence and a sense of ownership over their work, fostering intrinsic motivation and a stronger sense of self, enhancing their sense of self and purpose (Rojas-Torres et al., 2020).

Structured art programs, social media, and exhibitions provided avenues for skill development and public recognition. Consistent with studies by Yucesoy et al. (2020), these programs offered autistic individuals social connections, a sense of community, and self-esteem. However, caregivers highlighted the need for more inclusive programs designed explicitly for autistic individuals. Gabarron et al. (2023) reported that social media is a valuable tool for connecting communities and accessing resources, highlighting its potential for promoting social inclusion for autistic individuals. However, caregivers reported challenges in finding art programs specifically designed for autistic individuals, indicating a need for more inclusive options.

Exploring other art forms, such as music and building blocks, offered alternative avenues for creativity and sensory engagement, aligning with studies on sensory-based play (Yustesari et al., 2023). Engaging in diverse art forms helped broaden their creative experiences and provided complementary cognitive and emotional benefits.

Caregivers used social media to promote participants' work, helping them gain financial rewards and public exposure, which aligns with findings that digital platforms support autistic artists in building sustainable careers (Gabarron et al., 2023). While social media expanded its audience, limited marketing resources hindered broader visibility. Support from teachers and caregivers was essential for navigating the art market, and financial rewards motivated participants by linking art sales to tangible benefits, reinforcing their commitment to artmaking.

Finally, art proved to be a calming activity that supported emotional regulation and provided participants with structured, self-directed engagement. Drawing, in particular, served as a stimming activity, helping manage sensory overload and maintain stability, consistent with Schweizer et al. (2020), who discovered that art can serve as an effective self-regulation tool for autistic individuals. The ability of art to occupy time productively and provide a sense of purpose further supports its value in enhancing the quality of life, particularly for individuals who benefit from structured, repetitive, and self-directed activities (Yustesari et al., 2023).

6. Conclusion

This study highlights art's profound impact on autistic individuals, offering a foundation for skill development, self-expression, sensory management, and social inclusion. Art provides a unique, non-verbal platform for communication and allows autistic individuals to engage meaningfully with their world, emphasizing the need for inclusive, accessible programs to maximize its potential. Future research could investigate the benefits of different art forms and the role of digital platforms in promoting autistic artists.

Artistic activities are shown to enhance employability for autistic individuals by enabling self-expression, developing fine motor and cognitive skills, and fostering career-related abilities. Aligning with Bernier et al. (2022), this study suggests that art serves as both a therapeutic and developmental tool, supporting growth in various domains.

Art also enhances communication for non-verbal autistic individuals, suggesting that art-based programs could be further incorporated in educational and therapeutic settings. By enabling autistic individuals to explore their creativity, these programs could help them develop skills for potential careers in the arts. Round et al. (2017) advocated for additional marketing support to help autistic artists navigate the art market, which this study also recommends.

However, the study encountered several limitations. The small sample size and the focus on a specific cultural context—Malaysia—restrict the generalizability of the findings to broader populations. This limitation is compounded by the study's narrow demographic scope, which may not fully represent the diverse experiences of autistic individuals globally. Additionally, the reliance on qualitative data from caregivers could introduce bias and affect the objectivity of the results. Future research should aim to include more extensive, more diverse samples and investigate the long-term impacts of sustained art engagement on career development for autistic individuals. Sampurno et al. (2020) discovered that expanding the research to different cultural settings and including quantitative measures alongside qualitative insights could provide a more comprehensive understanding of the topic. Furthermore, longitudinal studies could provide deeper insights into the long-term benefits of art therapy for non-verbal autistic individuals. Exploring the impact of different art forms and techniques could also help tailor more personalized therapeutic interventions.

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THE DEVELOPMENT OF SCANSERVE – SMART QR-DRIVEN SUMMONS APPLICATION FOR STREAMLINED DISCIPLINARY CASE MANAGEMENT: A STEP TOWARDS A SMART CAMPUS

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ABSTRACT

To create a more efficient and technologically advanced campus environment, this paper presents the development of a Smart QR-Driven Summons Application for streamlined disciplinary case management. Leveraging the Mobile Application Development Life Cycle (MADLC) as the methodology, using Android Studio and Firebase, the system is designed to automate and enhance the traditional method of issuing and managing disciplinary summons within academic institutions. The proposed solution integrates Quick Response (QR) code technology, enabling the rapid generation, distribution, and tracking of summonses via mobile devices. This innovation not only reduces the administrative burden but also minimises errors associated with manual processes. A detailed system interface is presented to illustrate the application's functionalities and user experience. To evaluate the effectiveness and usability of the application, a System Usability Scale (SUS) test was conducted, yielding positive results that underscore the potential of the application in contributing to the development of a smart campus ecosystem. The findings demonstrate the application's capability to improve operational efficiency and user satisfaction, marking a significant step towards the digital transformation of disciplinary processes in educational institutions.

1. Introduction

With such tremendous growth in the usage of smart technologies, many universities are considering adopting the concept of a smart campus. A smart campus can be defined as deploying advanced information and communication technology (ICT) to enhance the effectiveness and efficiency of campus activities (Zhang, Yip, Lu & Dong, 2022). Traditional campuses have been transformed from paper-based to digital to smart campuses in the last three decades or so, depending on the location of the campus and resources (Alrashed, 2020).

Based on the literature, the enabling technologies for smart campuses include cloud computing, IoT, virtual reality (VR), AR, artificial intelligence (AI), and mobile devices. Zhang, Yip, Lu, and Dong (2022) have categorised them into 5 domains: data computing and storage technologies, IoT technologies, intelligent technologies, immersive technologies, and mobile technologies. In a unified view proposed by Alrashed (2020), the main components of smart campus management are communications with parents/students, reporting, and transparency. Qurtubi, 2022, highlighted that the provision of applications and content of campus services need to be implemented to support the convenience of students.

Campus regulations are crucial in promoting safety and security. By enforcing these rules, universities can create a safer environment, minimising risks to students and staff. Clear regulations provide mechanisms for resolving disputes and handling misconduct, essential for maintaining a peaceful and productive campus environment. Students and staff indirectly understand the expectations and consequences of their actions, ensuring that the academic and social environment remains conducive to learning and personal growth. The following are examples of rule violations within the campus: violations of dress code, unauthorised parking and unregistered vehicles, exceeding the vehicle speed limit, failure to wear helmets on campus, and possession of prohibited items.

The main problem of a paper-based summons system is its manual processing, which causes delays in issuing and delivering the summonses (Mohd Noor, 201). Manual entry and processing also increase the likelihood of mistakes, such as incorrect details on the summonses, misplacement of documents, or issuing summonses to the wrong individuals. Tracking paper summonses can be challenging, especially in large institutions. There is a higher risk of documents being lost, misplaced, or not delivered to the intended recipients (Abdullah, 2013). A more efficient, transparent, and secure system for handling disciplinary cases is needed.

By leveraging QR code technology coupled with mobile devices, the application aims to simplify and modernise administrative procedures, reduce manual data entry, and improve the overall efficiency of campus regulation management. This technological advancement will reduce administrative burden, contributing to a broader goal of creating a smart campus environment.

The main contribution of this project is the development of a smart QR-driven summons application to store campus rule violation case records and facilitate the offenders (students and staff) and the enforcement team in making quick and accurate checks on summonses.

2. Literature Review

The QR code technology, an essential component of the Smart QR-Driven Summons Application project, is a dynamic and efficient tool for encoding and decoding information. As Suwait (2016) explains, a QR code, short for "Quick Response," is a matrix bar code or two-dimensional code designed to store various types of data information. Recognisable by its square pattern of black modules on a white background, a QR code can contain text, URLs, or other data,

allowing quick decoding at high speeds. This technology has gained widespread popularity globally, with the prevalence of mobile phones equipped with cameras enabling seamless recognition of QR codes. Notably, QR codes can store substantial information, making them versatile for many applications.

The QR codes have been used widely, especially in tasks like payment and ticketing. Beyond these applications, QR codes offer many advantages, particularly in campus environments. According to Prasad et al. (2023), QR codes can significantly promote smart campuses by providing quick access to information. The numerous advantages of QR codes include their high data capacity, compact size, resistance to dirt and damage, adaptability to various scanning angles, and structured aggregation. These features collectively make QR codes an efficient and versatile tool for enhancing information accessibility and interaction within a campus setting.

The integration of QR technology in taking attendance can be seen in Vinoth, Gokulraj and Gopinath; Bakar et al., 2021; Agripa and Astillero, 2022), library management system (Din & Fazla, 2021), hostel residents management system (Olaiya, 2021), café food ordering (Masandig, Azhari, Hisham & Hisham, 2022), campus routing for indoor navigation (Padmaja et al., 2022), keyless entry system, and campus office management system (Dagtekin, Gümüş, & Olca, 2022). Examining similar summons systems or related works offers valuable insights when developing smart QR-driven summons applications. The comparison between the features in the existing similar summons systems and the proposed system can be seen in Table 1.

Table 1

Summary of comparison between the proposed system and existing systems

Features	ScanServe – Smart-QR Driven Summons Application	MyBayar PDRM	MyJPJ	VROOM: Vehicle Registration and Summons on the Move (Selamat & Sim, 2016)	E-Summons UTM (Mohd Rashid & Patel, 2018)	UTP m-Summons System (Mohd Noor, 2011)
Sign up/Login	✓	✓	✓	✓	✓	✓
Notification	✓	✓	✓	✓	✓	✓
Summons	x	✓	✓	x	x	✓
Payment						
Vehicle	✓	x	x	✓	x	x
Registration						
Summons Check	✓	✓	✓	x	✓	✓
Summons History	✓	✓	✓	x	x	✓
Summons Issuance	✓	x	x	✓	✓	✓
Image Evidence	✓	x	x	✓	x	✓
QR-code	✓	x	x	x	x	x

3. Methodology

Developing the Smart QR-driven Summons Application for managing campus regulation requires a structured approach that ensures efficient collaboration between developers, stakeholders, and end-users. MADLC is a proven methodology that guides the comprehensive development of mobile applications, emphasising features and design. MADLC's distinct phases

provide a systematic and organised progression that contributes to the application's functionality, user-friendliness, and overall success in addressing the challenges in campus regulation management. Vithani and Kumar (2014) highlighted MADLC's track record of success in the realm of Android mobile application development, making it a reliable approach to guide the development process of this application.

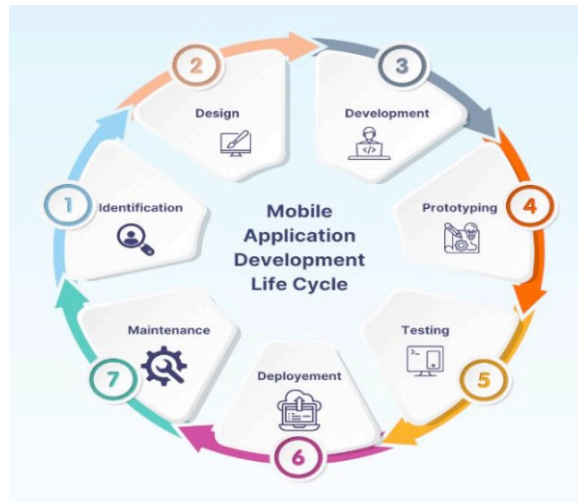


Figure 1. MADLC Phases

4. Proposed Framework

Figure 2 shows the system architecture framework of the Smart QR-Driven Summons Application, consisting of three main components, which are a mobile application for students and staff, a database, and an administrator interface. The administrator can register students and staff and generate a unique QR code linked to their personal information in the database. However, to facilitate the process, the developed system will be linked to a university's main database to directly obtain the data of all students and staff. This removes the tedious and time-consuming manual registration of each staff/student by the administrator. Enforcement officers known as 'Polis Bantuan' (PB) can identify students and staff by scanning the QR code on their phone or a sticker on their vehicle (for traffic-related rule violations). When issuing summonses, the PB can upload evidence like photos directly through the application, which generates a digital summons slip. Students and staff can view summons details on the application as well. All data, including summons history, is securely stored in the central database, accessible by authorised personnel through the administrator interface for tracking, reporting, and analysis.

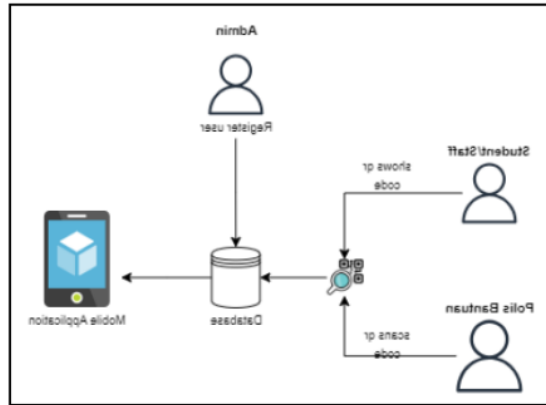


Figure 2. System Architecture Framework of Smart QR-driven Summons Application

As shown in Figure 3 below, the activity diagram for the summons process within the Smart QR-Driven Summons Application illustrates a seamless sequence of actions involving users, including students, staff, the PB, and the system. With a successful login, users are provided with a QR code, facilitating the input of personal details, subsequently stored in the system for access. The streamlined process lets users receive summons details promptly, concluding with a system notification of completed summoning and application closure.

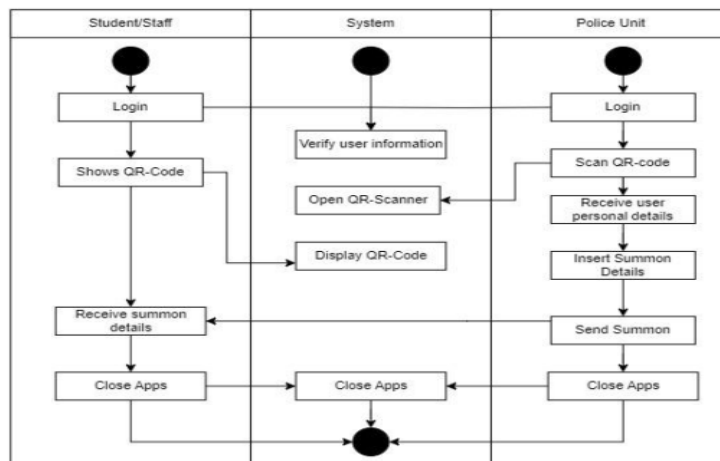


Figure 3. Activity Diagram of Smart QR-driven Summons Application

The Use Case Diagram for the Smart QR-Driven Summons Application for managing campus regulation (shown in Figure 4) is a comprehensive representation of the interactions between different actors (students/staff, administrators, and the PB) and the various functionalities of the application. It covers all the essential operations, including registering vehicles, receiving and viewing summonses, generating and scanning QR codes, and managing users, summonses, and vehicles. Each actor's role is clearly defined, showing how they engage with the system to accomplish specific tasks.

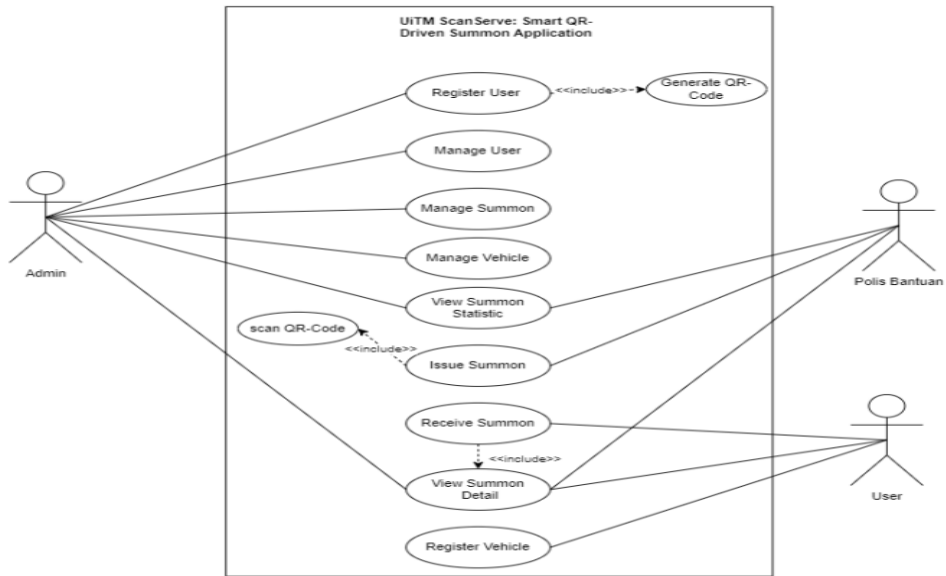


Figure 4. Use Case Diagram of Smart QR-driven Summons Application

5. Implementation

The first step during the initial phase of developing the Smart QR-Driven Summons Application is creating a project in Android Studio. This involves setting up a new project within the Android Studio IDE, which includes specifying the project's name, selecting the appropriate SDK, and configuring the project structure. After initialising the project, new Java classes are created to define the application's functionalities and structure. These classes encompass various application components, such as user interfaces (UI), data models, and logic controllers. Coding functionalities using the Java programming language are essential at this stage, where core features of the application are implemented. Additionally, necessary libraries and dependencies are imported into the project's files to enhance functionality and ensure smooth operation.

The UI can be developed for Android development using XML, a markup language designed explicitly for creating structured data and layouts within Android Studio. This approach allows developers to efficiently design and define the application's interface, including layouts, widgets, buttons, graphics, and text.

To deliver a reliable real-time database service from Google, integrating the Firebase Database is essential for this project. This integration allows the mobile application to handle and store all user data effectively. The project configuration includes adding the Firebase SDK to the file, establishing a connection to Firebase, and enabling access to its robust functionalities. This setup allows the mobile application to save and retrieve user data quickly, ensuring that the most recent information is synchronised across all linked devices in real time.

QR codes are generated for students and staff containing essential user information such as full name, email, and ID number. These QR codes are crucial when PB officers scan them to issue summonses efficiently. To implement this functionality, the ZXing library is integrated into the project's file to facilitate QR code generation. Upon registration of a student or staff member, the application automatically generates a unique QR code containing the specified user details. These

QR codes are stored in Firebase storage in image format. This approach ensures that the QR codes are securely saved and can be easily retrieved by users when needed.

To facilitate QR code scanning by the PB, the application integrates the ZXing barcode scanner library. This library enables the mobile device's camera to scan QR codes efficiently during summons issuance. The integration involves requesting permission to access the device's camera, ensuring seamless functionality without compromising user privacy. By leveraging the ZXing library, the application provides a user-friendly interface for scanning QR codes, enabling PB officers to quickly retrieve user information needed for issuing summonses.

6. System Interface

Figure 5 below shows the Landing and Login page of the ScanServe — Smart QR-Driven Summons Mobile Application. On this page, administrators, students, staff, and PB personnel log in using their official organisation's email addresses. For first-time users, the initial password is set to their email address, which can be changed after logging in. This secure and streamlined login process ensures that only authorised users can access the system, maintaining the integrity and confidentiality of the application's data and functions.

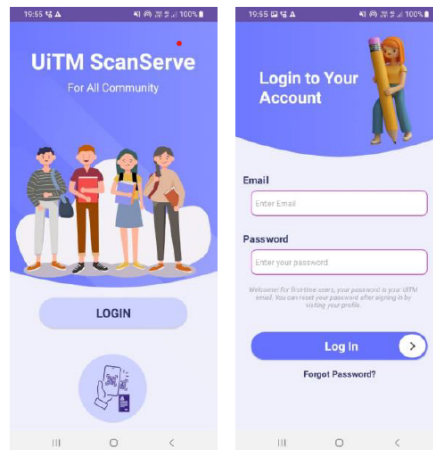


Figure 5. The Landing and Login Page of the ScanServe Mobile Application

Figure 6 shows the admin dashboard, which displays all of the features available to administrators. It includes a welcome message that greets users by their email address.

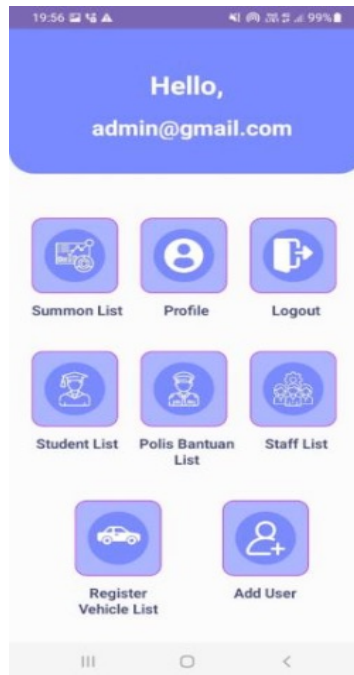


Figure 6. Admin Dashboard

Figure 7 shows the Registered Vehicle List page, displaying only the vehicles that users have registered. Administrators can view and search for vehicles by their plate number, ensuring all registered vehicles are accounted for within the system.



Figure 7. Registered Vehicle List

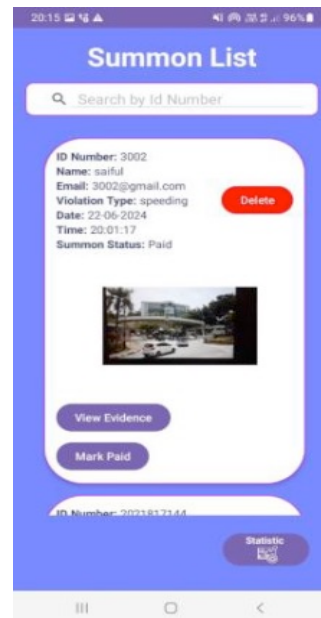


Figure 8. Summons List

Figure 8 shows the Summons List page for administrators. Here, administrators can view a comprehensive list of all summonses issued by the PB. Administrators can update the status of each summons, marking it as paid if the user has settled the fine. Additionally, admins can search for summonses by user ID number and have the option to update the details of any summonses in the list.

Figure 9 shows the QR Scanner page, which activates the PB camera to scan the QR codes of students or staff for summoning purposes. This feature simplifies issuing summonses by retrieving the stored details from the QR code. Figure 10 shows the generated information when the QR code has been scanned.



Figure 9. QR Scanner Page

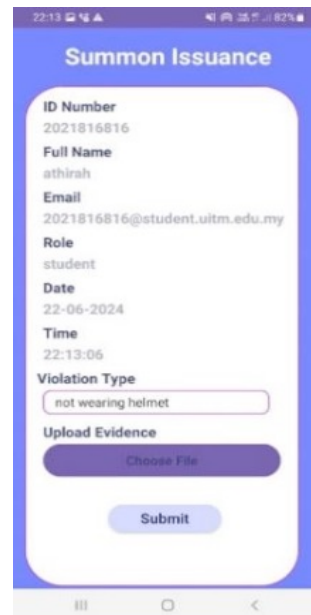


Figure 10.
Generated Data from QR Code

Figure 11 shows the Statistics page, where administrators can view the count of summonses for each violation type within a selected month and year. This feature helps in analysing trends and understanding the distribution of different types of violations over time.



Figure 11. Statistics Page

Figure 12 showcases the user dashboard, featuring a welcoming message with the user's email and displaying the current count of summons associated with the user. The dashboard includes buttons for accessing all available functions and features a navigation bar at the bottom of the page for easy navigation.

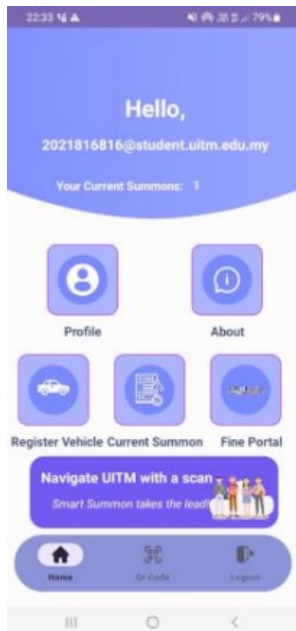


Figure 12. User Dashboard



Figure 13. QR Page

Figure 13 features the QR code page, displaying the QR code unique to users with their ID number. This QR code contains user details necessary for summoning purposes and can be saved as an image to the user's phone gallery for convenient access without logging into the application.

Figure 14 and Figure 15 illustrate the pages for registering a vehicle and viewing registered vehicles, respectively. Users can register their vehicles in the application by providing details and uploading an image of their license. After registration, users can access the User Vehicle page to view their previously registered vehicle details.

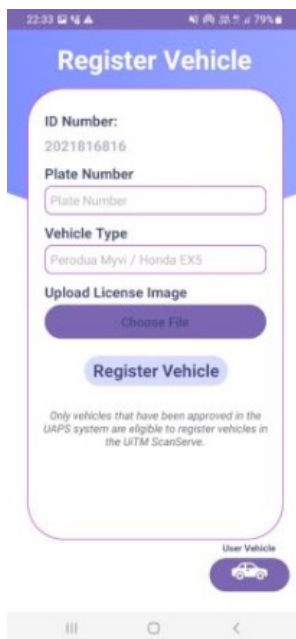


Figure 14. Vehicle Registration Page

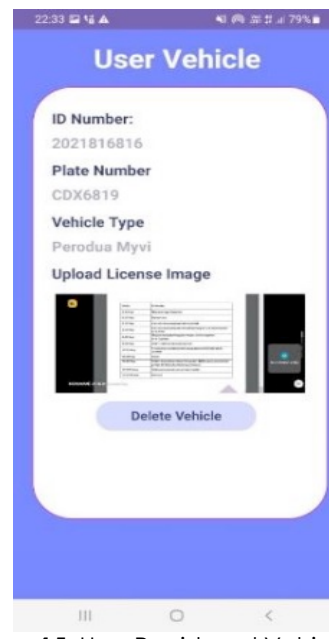


Figure 15. User Registered Vehicle List

Figure 16 depicts the User Summons List page, displaying summons details specific to the logged-in user. Users can view the status of all summonses, which function as digital summons slips. Additionally, users can access the evidence provided by the PB, justifying why each summons was issued.

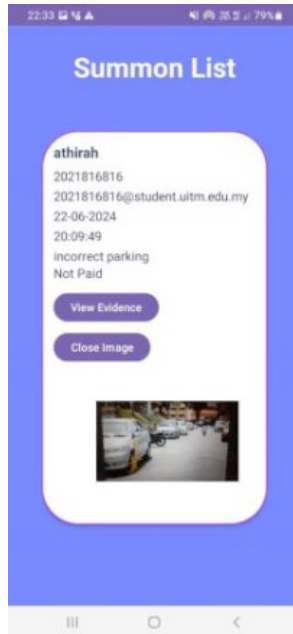


Figure 16. Summons List Page

7. Testing and Validation

After completing the implementation phase, the testing phase becomes crucial. This phase involves a comprehensive series of actions to research and analyse the actual levels of performance and quality of the project. Testing is essential to verify the actual versus expected results, ensuring the application undergoes a thorough testing before it is released to the user post-development. This process guarantees practical functionality and alignment with user requirements. The usability testing was performed by five users from the stakeholder groups — students, staff, and the PB. 80 percent of usability problems can be identified with a sample of five users, a principle known as the 'magic number' (Alroobaea & Mayhew, 2014). The selected users tested the application and then answered the provided questions via Google Forms. The list of questions used for the testing is shown below.

In evaluating the system's usability, the heuristics evaluation employs the SUS, a widely recognised tool consisting of a questionnaire with a scale ranging from 1 (strongly disagree) to 5 (strongly agree). Based on 10 standardised statements, this scale measures users' perceptions of the application's usability. The SUS helps quantify subjective user experiences and identifies areas for enhancement by assessing factors such as ease of use, integration of functions, and confidence in the system. The sample of SUS questions used is as follows:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.

6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

8. Results and Discussion

The testing phase results based on user responses were classified into ease of use, integration of functions, and confidence in using the system and are presented in the following figures below:

8.1 Perception of System Complexity

The research findings on the Smart QR-Driven Summons Application's complexity are encouraging and significant. The responses in Figure 17 show that 60 percent of the users strongly disagreed (77 rated 1) that the system was unnecessarily complex, and 40 percent disagreed (rated 2). No users rated the complexity at levels 3, 4, or 5. These results indicate a consensus among participants that the application is simple, suggesting its straightforward and user-friendly design. This perception of simplicity is crucial for ensuring ease of adoption and effective use across different user groups within the university.

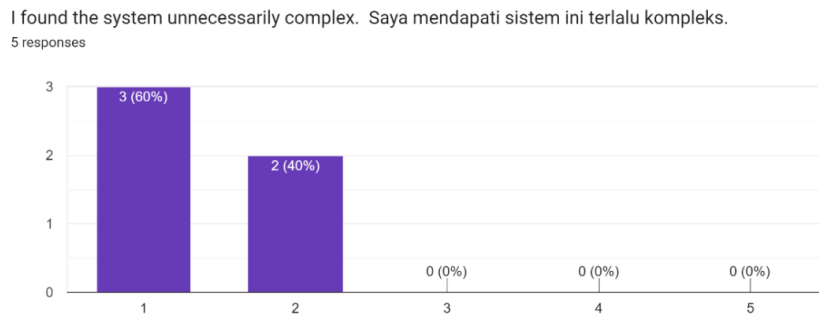


Figure 17. Evaluation of System Complexity

8.2 Ease of Use

As shown in Figure 18, 60 percent of participants rated the ease of use of this system as 4, and 40 percent rated it as 5, indicating a high level of agreement that the system is user-friendly. No participants rated the ease of use below 4, underscoring the application's intuitive design and accessibility.

I thought the system was easy to use. Saya fikir sistem itu mudah digunakan.
5 responses

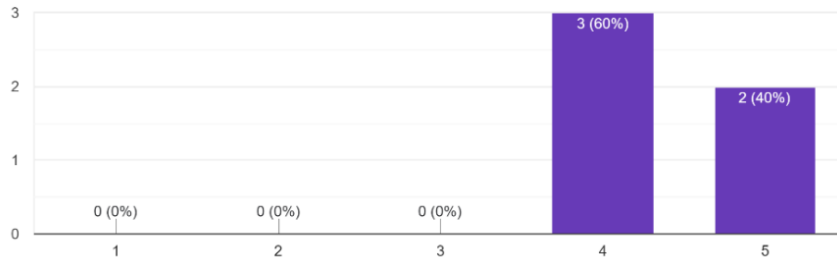


Figure 18. Ease of Use Evaluation

8.3 Integration of Functions

As shown in Figure 19, participants largely agreed that the various functions in the system were well integrated, with 80 percent rating it as 5 and 20 percent rating it as 4. No participants rated it below 4, indicating a strong perception of cohesion and seamless operation within the application's features.

I thought there was too much inconsistency in this system. Saya fikir terdapat terlalu banyak ketidakkonsistenan dalam sistem ini.
5 responses

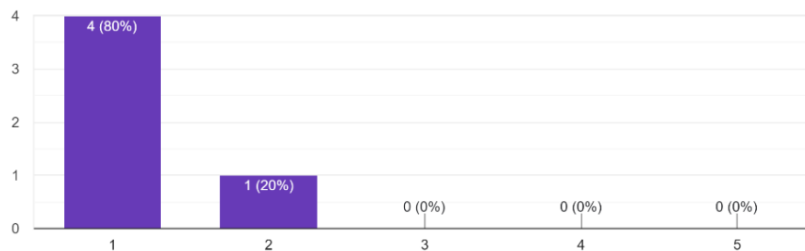


Figure 19. Integration of Functions

8.4 System Consistency

When asked about inconsistencies within the system, 80 percent of participants strongly disagreed, and 20 percent disagreed, as shown in Figure 20 below. No participants rated the system as inconsistent, highlighting a consensus that the application is consistent in its operation and presentation.

I found the various functions in this system were well integrated. Saya mendapati pelbagai fungsi dalam sistem ini diintegrasikan dengan baik.

5 responses

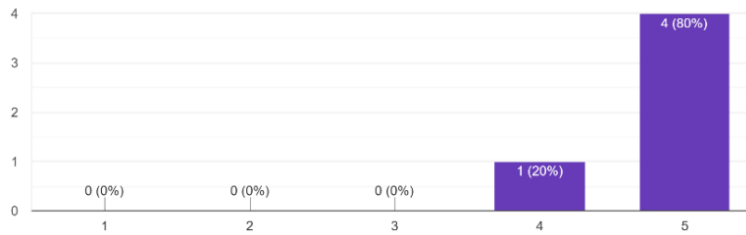


Figure 20. System Consistency

The application, designed to streamline this process using the QR code technology, received positive feedback from a diverse group of users, including students, staff, and PB personnel. Results from the SUS indicated high levels of user satisfaction, with users praising the application's ease of use, integration of functions, and efficiency improvements in summons management.

9. Limitations of the Study

The ScanServe — Smart QR-Driven Summons Application relies on QR codes for submitting cases. However, a QR code might fail to work, either from a technical perspective or due to user or environmental factors. The main reason might be poor image quality caused by the scanning device not being able to detect the code properly. Since QR code functionality relies on high contrast between the dark and light areas (typically black and white), if the code is printed or displayed with low contrast (e.g., dark grey on black), the scanner may not be able to distinguish the code pattern. The scanners may also struggle to detect the details necessary for decoding if the QR code displayed is too small. Environmental factors such as poor lighting conditions or excessive glare can make it difficult for a device's camera to focus and scan the QR code. This includes QR codes printed on glossy or reflective surfaces (e.g., laminated cards or screens with glare) that can cause light reflections that interfere with scanning. Furthermore, poor or no internet connectivity on the user's device can prevent the QR code from working, even if it scans properly.

10. Conclusion

The ScanServe — Smart QR-Driven Summons Application for managing campus regulation significantly advances how university communities handle regulatory processes. The system provides a user-friendly and efficient mobile application, encouraging greater user engagement and improving compliance with campus regulations. This application eliminates the need for manual paper-based methods, streamlining summons issuance process and reducing errors.

11. Future Work

Suggestions for potential enhancements to the developed system include the integration of a payment gateway, an appeal for a fine reduction menu, enhanced notification alerts, and data visualisation for statistical reports. Additional features, such as manually inputting a case ID or selecting the case from a dropdown list that encounters a QR code scanner failure will be considered.

11.1 Integration of Payment Gateway

Integrating a secure direct payment system within the application would significantly streamline the process for users, allowing them to pay fines directly through the application. This would eliminate the need for users to navigate to an external portal, thus enhancing convenience and reducing the likelihood of missed or delayed payments.

11.2 Appeal for a Fine Reduction Menu

Another recommendation is to extend the application's feature to handle appeals process. Although these tasks are typically conducted physically at the PB office, incorporating these functions into the application could streamline the process and significantly reduce administrative burdens.

11.3 Enhanced Notification Alerts

Implementing real-time notifications to alert users upon receiving a summons would significantly improve user awareness and responsiveness. While the current project setup using Firebase does not support this feature, incorporating a backend server capable of handling real-time communication could enable timely notifications, ensuring users are promptly informed about their summons status and making them feel more in control of the situation.

11.4 Data Visualisation for Statistical Reports

Enhancing data visualisation within the application using charts and graphs to represent statistical data would make the application more user-friendly. Visual representations of data on summons statistics, such as the number of summonses issued per violation type or trends over time, would provide users and administrators with more precise insights and facilitate better decision-making.

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Authors Contributions

Wan Fariza Wan Abdul Rahman: Conceptualization, Original draft preparation, Supervision, Writing, Reviewing and Editing. Nur Athirah Su'aidah Abu Samah: Investigation, Writing - Original draft preparation, Data curation, and Visualization

Conflict of Interest

The authors report no conflicts of interest.

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THE INFLUENCE OF WOMEN'S EARNING STATUS AND OTHER SOCIOECONOMIC FACTORS ON THEIR HEALTHCARE-SEEKING BEHAVIOR: EVIDENCE FROM THE BANGLADESH HOUSEHOLD INCOME AND EXPENDITURE SURVEY, 2016

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ABSTRACT

Economic progress is intricately tied to the concept of human capital. The active participation of women who earn income plays a significant role in mitigating poverty and addressing gender disparities. Consequently, in the pursuit of fostering sustainable economic development, a comprehensive exploration of women's health concerns becomes imperative. The acquisition of accessible and qualified medical care stands as a vital component in preserving overall well-being. Regrettably, women residing in numerous underdeveloped nations often neglect this fundamental necessity. Improving healthcare-seeking behavior (HSB) is considered a vital strategy to optimize the utilization of healthcare services. However, women in the majority of developing countries demonstrate inadequate healthcare-seeking behavior (HSB). This study seeks to evaluate the influence of women's earning status and other socioeconomic factors on their HSB, using data from the Bangladesh Household Income and Expenditure Survey (HIES) 2016. Here we considered those women who were ill and sought any type of treatment during the 30 days of the survey. Based on Andersen's behavioral model of health services use, this study employed a multinomial logistic regression model. The findings indicate that while women's educational attainment, urban residence, and chronic illness elevate the likelihood of seeking qualified healthcare

providers, women who have income are more inclined to seek treatment from a pharmacy/traditional/self-care. These findings underscore the necessity for initiatives aimed at improving the HSB among women who have income and those residing in rural areas.

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1. Introduction

There is a prevailing belief that the value attributed to women's health is predominantly associated with their reproductive capacity (Bustreo et al., 2012). However, the domain of women's health has undergone significant transformations, shifting its focus from a limited emphasis on child and maternal health to a broader framework encompassing sexual and reproductive health. Moreover, this broader perspective has further expanded to incorporate the holistic concept of women's health, which is based on a life-course perspective. Women's healthcare plays a crucial role in fostering social development by empowering women, amplifying their contributions to society, and promoting sustainable development (Langer et al., 2015). The health of women exerts a substantial and positive influence on enhancing economic growth in underdeveloped nations (Bloom et al., 2019, 2020).

In most developing countries, women are more vulnerable to extreme poverty. However, combating hunger and poverty requires the empowerment of women (FAO, 2017). Through active engagement in the labor market and participation in community affairs, women assume a pivotal role in the implementation of poverty alleviation strategies. Enhancing female employment opportunities and augmenting their income levels substantively contribute to the reduction of poverty rates and foster economic growth (Maligalig et al., 2019). Empirical evidence from China affirms a positive correlation between women's empowerment and the mitigation of poverty (Gu & Nie, 2021).

In the world survey on the role of women in development, it has been found that due to their disproportionate share of unpaid caregiving and household work, women face significant time limitations, restricted access to adequate jobs, healthcare, and education, and the risk of capacity depletion in the absence of supportive legislative frameworks (UN Women, 2020). The simultaneous responsibilities of caring for family members and maintaining employment pose significant risks to women's health, which can lead to adverse outcomes (Chen et al., 2020). However, negative health outcomes affect their productivity. It is evident from research done by the Work and Opportunities for Women (WOW) program in Bangladesh that women experience health issues and exhaustion as a result of performing dual jobs. Women claim that missing work damages their professional reputation, increases their chances of job loss, and prevents them from being promoted to better jobs (WOW, 2020).

Higher women empowerment means higher use of healthcare facilities (Ahmmed, 2022), and it also increases maternal healthcare utilization (Haider et al., 2017). Health and women's empowerment are intrinsically linked. We can improve women's quality of life and, in turn, contribute to their empowerment by offering better health services (Panchani, 2014). However, better health outcomes are unlikely to result from increasing access to subpar treatment (Kruk et al., 2018). It was estimated that a significant proportion of antibiotic prescriptions in Bangladesh, specifically 63%, originates from unqualified healthcare providers. Moreover, antibiotics are

prescribed in almost half, precisely 44%, of all consultations within primary healthcare settings (SIAPS, 2015).

Frequently, healthcare prescribers would diagnose a microbial infection relying on signs and symptoms, choosing to prescribe antimicrobials based on empirical evidence rather than adhering strictly to established treatment protocols (Faiz & Basher, 2011). This phenomenon results in the generation of misconceptions and dissemination of inaccurate information regarding illnesses and diseases, ultimately leading to the irrational and improper administration of antibiotics among various patients (Nahar et al., 2020; Pulla, 2016).

Improving healthcare-seeking behavior (HSB) is considered a vital strategy to optimize the utilization of healthcare services. HSB can be defined as the actions taken by individuals who subjectively experience or perceive themselves to be unwell or facing a health issue to identify an appropriate solution (Ward et al., 1997). However, HSB among women is poor in most developing countries. In Eastern Ethiopia, 74.3% of women sought antenatal healthcare from a healthcare facility, whereas only 22.6% sought postnatal healthcare (Kifle et al., 2017). In Zambia, around 60% of patients sought treatment from healthcare providers, 30% treated themselves, and 10% did not seek any type of treatment (Masiye & Kaonga, 2016). This relates not only to maternal healthcare; during pregnancy, women experienced illnesses and did not seek proper healthcare.

In China, only 25.97% of women with female diseases (such as menopausal symptoms) sought healthcare (Du et al., 2020). In Egypt, a significant majority of women, amounting to 89.2%, refrain from seeking medical treatment for urinary incontinence (Ahmed & Zaky, 2016). Only 14.2% of women with cervical cancer sought healthcare in Ethiopia (Habtu et al., 2018). In Nepal, around 50% of women experiencing any illness first sought treatment from traditional healers (Shrestha et al., 2017). One study (Reddy et al., 2020) reported that only 34% of rural women in Telangana, India, sought medical treatment after the symptoms of illness appeared. In Bangladesh, women's healthcare-seeking behavior is inadequate (Hamiduzzaman et al., 2023; Khan et al., 2018; Yaya et al., 2017). A prior investigation carried out in Bangladesh revealed that 47.3% of women residing in rural areas did not avail themselves of any medical examinations throughout their pregnancies (Hossain, 2020).

The purpose of this study is to emphasize the need for policymakers to prioritize the improvement of women's health-seeking behavior (HSB) in relation to various illnesses rather than solely focusing on maternal healthcare-related concerns. However, a significant proportion of women still do not seek proper treatment in developing nations, which may harm health outcomes. As the dual jobs of women affect their health, it is of utmost importance to examine the effects of women's earning status and other socioeconomic factors on their healthcare-seeking behavior. This examination will help policymakers realize where and how to focus their efforts in contributing to improving women's healthcare, better employment, and empowerment, ultimately leading to social and economic development in developing countries.

2. Literature Review

The demand for modern healthcare depends on age, user fees, education, economic well-being, and distance to healthcare providers (Masiye & Kaonga, 2016; Paudel, 2019; Wellay et al., 2018; Zhang et al., 2020). The age of women and chronic illness are influential factors in their health-seeking behavior and exhibit a positive correlation in Egypt, as indicated by Ahmed and Zaky (2016). The type of illness is a significant factor influencing HSB. Women who have chronic illnesses are more inclined to seek healthcare services from qualified providers (Ahmed & Zaky,

2016; Gabrani et al., 2021). The distance and region of residence have a significant impact on the choice of healthcare providers (Kassim, 2021; Liu et al., 2019; Masiye & Kaonga, 2016).

Various factors, including individual, societal, sociodemographic, and health service factors, have an impact on the maternal healthcare-seeking behavior of women (Kifle et al., 2017). In China, urban women exhibit a higher propensity to pursue medical treatment in secondary or tertiary healthcare facilities in comparison to their rural counterparts (Liu et al., 2019; Yanikkerem et al., 2013). Whether in rural or urban areas, the education and paid employment of women have a positive impact on their utilization of healthcare services (Wado, 2018).

Women who have income are expected to improve their socioeconomic status, which can influence their decision-making power and result in their seeking proper healthcare. Women's empowerment and proximity to healthcare facilities are significant factors influencing healthcare-seeking behavior among rural women (Reddy et al., 2020). Numerous studies have established a strong and positive correlation between employed women and maternal or reproductive HSB in Bangladesh (Hossain, 2020) and in Ethiopia (Wado, 2018), as well as making their own healthcare decisions in Bangladesh (Hasan & Uddin, 2016). In contrast, in Nepal, although women's education was positively related to maternal healthcare service use, women's employment was negatively related to maternal healthcare service use (Matsumura & Gubhaju, 2001). Most studies have focused on maternal healthcare among women.

3. Methodology

3.1. Theoretical Background

The Behavioral Model of Health Services Use (Andersen, 1968) has been applied in this study, following previous studies (Khanam & Hasan, 2020; Lo et al., 2016; Slobbe et al., 2017; Sreeramareddy et al., 2012), to determine influential factors of HSB among ill women in Bangladesh. This theory (Andersen, 1968), moderated by Andersen and Newman (1973), assumes that the utilization of healthcare services by an individual is influenced by three distinct factors: predisposing, enabling, and need factors (also known as severity of illness).

The predisposing component attempts to explain an individual's inclination to seek medical assistance before the onset of a sickness episode. It includes characteristics related to demographics, social structure, and beliefs. Variables that contribute to the fulfillment of an individual's healthcare needs are commonly identified as enabling factors. They consist of variables that indicate family characteristics and community resources. The severity of an individual's illness determines whether or not they need to seek medical help. It includes the individual's perceptions of sickness and their assessed levels of illness.

3.2. Data Source

This research constitutes a cross-sectional study that relies on secondary sources of data. The data were collected from the Bangladesh Household Income and Expenditure Survey (HIES) 2016, which was carried out by the Bangladesh Bureau of Statistics (BBS) of the Statistics and Informatics Division (SID). The World Bank and World Food Programme provided financial and technical assistance. In the process of collecting data, a stratified two-stage clustered sampling design was used in the HIES 2016 (BBS, 2017).

This study included a sample of women who were 18 years old and above and who had suffered from any illnesses during the last 30 days of the survey and sought any type of treatment. After cleaning the data, the total number of observations in this study was 11,967.

3.3. Statistical Analysis

Descriptive analysis has been conducted using frequency distribution, and a multinomial logistic regression (Ausserhofer et al., 2022; Wang et al., 2015) was used to examine the impact of the earning status of women and other socioeconomic variables on HSB in accordance with Andersen's behavioral model of health services use.

In the end, some diagnostic tests were run regarding the results of the multinomial logistic regression. The Hausman test, the Small-Hsiao test of the Independence of Irrelevant Alternatives (IIA) assumption, and the Wald test for the goodness of fit of the model were applied. All the data were analyzed using STATA 16.

3.4. Conceptual Framework

The conceptual framework of this study is illustrated in Figure 1, in which the earning status of women is identified as a predisposing factor. Additional socioeconomic factors are categorized into predisposing, enabling, and need factors in accordance with the definitions outlined in Andersen's behavioral model of health services use, as modified by Andersen and Newman (1973). In Figure 1, the predisposing factors encompass the age of women, religion, education level, and earning status of women. Enabling factors include the wealth index, size of the household, and distance to healthcare providers. Need factors consist of type of illness, health status, and delayed treatment.

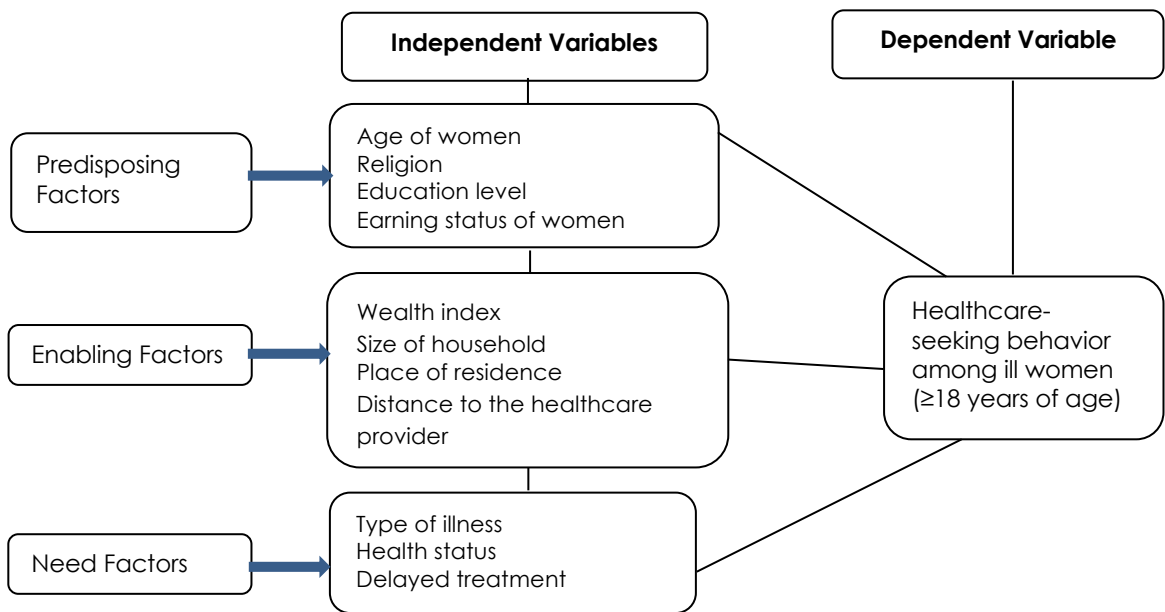


Figure 1. Conceptual Framework for HSB among ill Women

3.5. Variables Description

In this study, the HSB among ill women (≥ 18 years of age) is defined or measured as a categorical variable, including the following options:

- (i) Qualified healthcare provider
- (ii) Non-qualified healthcare provider
- (iii) Pharmacy/traditional/self-care

A qualified healthcare provider is defined as a registered and trained physician who obtained an MBBS degree. A non-qualified healthcare provider has no MBBS degree but has some kind of training or experience (Rasul et al., 2019). Pharmacy/traditional/self-care refers to a healthcare provider operating in a pharmacy or dispensary; homeopath; ayurved, kabiraj, or hakim; or other traditional, spiritual, or self-treatment.

For implementing the objective of this study, the model can be written as:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + \beta_8 X_{8i} + \beta_9 X_{9i} + \beta_{10} X_{10i} + \beta_{11} X_{11i} + \epsilon \dots \dots \dots (1)$$

Where Y is the dependent variable; β_0 is the intercept term; $\beta_1, \beta_2, \beta_3 \dots$ are parameters; $X_1, X_2, X_3 \dots$ are independent variables; and ϵ is the random disturbance term. For Model (1), the dependent and independent variables, based on the conceptual framework and the available data, are defined in Table 1.

In Table 1, socioeconomic status is expressed as a wealth index (Amin et al., 2010; Ahmed & Yunus, 2020; Tahsina, 2017). It is a composite index composed of the key asset ownership of households (Bhuiya et al., 2007; Mahmood et al., 2010). Principal component analysis (PCA) was applied to produce a factor score for each household based on the assets list; then these were grouped into five quintiles from lowest to highest (poorest, poor, middle, rich, richest). We used the "pca" command in STATA 16.

Table 1
Dependent and Independent Variables

Variables		Definition
Dependent variable Healthcare-seeking behavior among women (≥ 18 years of age) (Y)		= 1 if treatment is sought from a qualified healthcare provider = 2 if treatment is sought from a non-qualified healthcare provider = 3 if treatment is sought from a pharmacy/traditional/self-care
Independent variables		
Predisposing factors	Age of women (X_1)	In years (continuous variable)
	Religion (X_2)	= 1 if Islam = 0 others (Hindus, Christians, Buddhists)
	Education level (X_3)	= 1 if passed primary level or more = 0 if otherwise (less than primary level)

	Earning status of women (X ₄)	= 1 if women have income = 0 if women have no income
Enabling factors	Place of residence (X ₅)	1= rural 2= urban
	Size of household (X ₆)	In numbers (discrete variable)
	Wealth index (X ₇)	Wealth index (poorest, poor, middle, rich, richest)
	Distance to the healthcare provider (X ₈)	= 1 if time to reach is >0.4 hour = 0 if time to reach is <0.4 hours
Need factors	Type of illness (X ₉)	= 1 if fever = 2 if diarrhea = 3 if pain/injury = 4 if blood pressure/heart disease = 5 if respiratory diseases = 6 if weakness/dizziness = 7 if female disease/pregnancy-related = 8 if others
	Health status (X ₁₀)	= 1 if women have any chronic illness = 0 if there is no chronic illness
	Delayed treatment (X ₁₁)	Delayed treatment = 0 if no delay = 1 if delayed 1 to 2 days = 2 if delayed 3 to 4 days = 3 if delayed 5 days or more

4. Results

Table 2 displays the descriptive statistics of healthcare-seeking behavior (HSB) among ill women. Approximately 43% of women seek treatment from qualified healthcare providers. About 23% of women seek treatment from non-qualified healthcare providers, and 34% seek treatment from pharmacy/traditional/self-care. The average age is about 41 years, and the average size of a household is 4.179. In our sample, about 90% of the women in this study follow the Islamic religion. About 45.20% of women have completed at least primary education. The percentage of women who have income, regardless of occupation, is 11.20%, and more women who have income sought treatment from pharmacy/traditional/self-care. More than 70% of ill women live in rural areas. Approximately 42% of ill women take more than 0.4 hours, or 24 minutes, to reach the healthcare provider. Additionally, 45.40% of women suffer from chronic illnesses. More women seek pharmacy/traditional/self-care for fever. Only 27.37% of ill women did not delay seeking treatment.

Table 2
Descriptive statistics of healthcare-seeking behavior (HSB) among ill Women

Characteristics	Total Population (N=11,967)		Qualified healthcare provider (n=5,117)		Non-qualified healthcare provider (n=2,763)		Pharmacy/traditional/self-care (n=4,087)	
	mean	Std.	mean	Std.	mean	Std.	mean	Std.
Age (years)	40.979	15.781	41.502	15.839	41.195	15.840	40.178	15.638
Size of household (numbers)	4.179	1.721	4.280	1.781	4.005	1.581	4.169	1.732
	N=11967	100%	n=5117	42.76%	n=2763	23.09%	n=4087	34.15%
Religion								
Islam	10711	89.50	4636	38.74	2473	20.67	3602	30.10
Others (Hindus, Christians, Buddhists)	1256	10.50	481	4.02	290	2.42	485	4.05
Education level								
Completed primary level or more	5409	45.20	2545	21.27	1061	8.87	1803	15.07
Otherwise (less than primary level)	6558	54.80	2572	21.49	1702	14.22	2284	19.09
Earning status of women								
Have income	1340	11.20	476	3.98	319	2.67	545	4.55
Have no income	10627	88.80	4641	38.78	2444	20.42	3542	29.60
Residence								
Urban	3483	29.11	1672	13.97	544	4.55	1267	10.59
Rural	8484	70.89	3445	28.79	2219	18.54	2820	23.56

Wealth index								
Poorest	2216	18.52	811	6.78	551	4.60	854	7.14
Poor	2394	20.00	898	7.50	652	5.45	844	7.05
Middle	2477	20.70	984	8.22	648	5.14	845	7.06
Rich	2435	20.35	1063	8.88	528	4.41	844	7.05
Richest	2445	20.43	1361	11.37	384	3.21	700	5.85
Distance to the healthcare provider								
Distance >0.4 hour	5032	42.05	3321	27.75	777	6.49	934	7.80
Distance <.04 hours	6935	57.95	1796	15.01	1968	16.60	3153	26.35
Health status								
Have chronic illness	5433	45.40	2717	22.70	1231	10.29	1485	12.41
No chronic illness	6534	54.60	2400	20.06	1532	12.80	2602	21.74
Type of illness								
Fever	4787	40.00	1380	11.53	1271	10.62	2136	17.85
Diarrhea	504	4.21	175	1.46	143	1.19	186	1.55
Pain/injury	2282	19.07	1108	9.26	489	4.09	685	5.72
Blood pressure/heart diseases	704	5.88	414	3.46	139	1.15	151	1.26
Respiratory diseases	499	4.17	273	2.28	115	0.96	111	0.93
Weakness/dizziness	966	8.07	413	3.45	249	2.08	304	2.54
Female diseases /pregnancy-related	662	5.53	476	3.98	77	0.64	109	0.91

Others	1563	13.06	878	7.34	280	2.34	405	3.38
Delayed treatment								
No delay	3275	27.37	1366	11.41	738	6.17	1171	9.79
Delayed 1/2 days	5161	43.13	1719	14.36	1324	11.06	2118	17.70
Delayed 3/4 days	1505	12.58	696	5.82	371	3.10	438	3.66
Delayed 5/more days	2026	16.93	1336	11.16	330	2.76	360	3.01

Source: Bangladesh HIES 2016; calculated by the author

The findings of the multinomial logistic regression analysis are displayed in Table 3 below, with results expressed in terms of both coefficients and average marginal effects (AME). The coefficient of the multinomial logit model can be interpreted in relation to the relative probabilities, while the average marginal effects can interpret the actual probabilities of any outcomes.

In Table 3, the average marginal effect of women's age is positive. This finding suggests that as women age, they are more inclined to seek healthcare services from qualified providers and less likely to seek help from non-qualified healthcare providers. However, women who belong to the Islamic religion are more inclined to seek qualified healthcare providers compared to those of other religions. Additionally, women who have completed at least primary education have a higher tendency to seek care from qualified healthcare providers compared to those with no education or lower than primary education. Women who earn or have income are less inclined to seek care from qualified providers and more likely to seek treatment from pharmacies/traditional/self-care, in contrast to non-earners or those who have no income.

The total number of household members also affects women's HSB. Women from households with a higher wealth index have an increased likelihood of seeking care from qualified healthcare providers and a decreased likelihood of seeking care from non-qualified providers, as well as pharmacies/traditional/self-care. Moreover, women residing in urban areas demonstrate a propensity to seek healthcare services from qualified professionals in comparison to their counterparts in rural areas. However, the greater distance does not hinder women from seeking qualified healthcare providers but rather discourages their utilization of pharmacy/traditional/self-care. Women with chronic illnesses are more likely to avail themselves of the services of qualified healthcare providers, while they are less likely to seek treatment from a pharmacy/traditional/self-care compared to women without chronic illnesses.

The type of illness that women experience is a key factor in determining their HSB. Specifically, women who suffer from conditions such as pain/injury, blood pressure/heart diseases, respiratory diseases, and female diseases/pregnancy-related issues are more likely to seek professional healthcare services and less likely to resort to pharmacy/traditional/self-care compared to those who are afflicted with fever. Delayed treatment for five days or longer increases the likelihood of seeking qualified healthcare compared to women who did not delay seeking treatment.

Table 3
Results of multinomial logistic regression with coefficients and average marginal effects (AME).

Variables	Qualified healthcare provider		Non-qualified healthcare provider		Pharmacy/traditional/self-care	
	Coefficient	AME	Coefficient	AME	Coefficient	AME
Age (in years)	0.004** (0.002)	0.0009***	-0.003 (0.002)	-.0008***		-.0001
Religion (reference group: others such as Hindus, Christians, Buddhists) Islam	0.289*** (0.078)	0.0459***	0.097 (0.081)	-.0061		-.0399***
Education level (reference group: less than primary level) Completed primary level or more	0.189*** (0.057)	0.0488***	-0.183*** (0.061)	-.0450***		-.0039
Earning status of women (reference group: have no income) Have income	-0.175** (0.077)	-.0228*	-0.122 (0.079)	-.0069		0.0298**
Wealth index (reference group: poorest)						
Poor	0.113 (0.078)	0.0053	0.207*** (0.077)	0.0277**		-.0329***
Middle	0.291*** (0.078)	0.0324***	0.274*** (0.078)	0.0254**		-.0578***
Rich	0.446*** (0.079)	0.0689***	0.178** (0.082)	-.0034		-.0656***
Richest	0.820*** (0.083)	0.1421***	0.152* (0.091)	-.0366***		-.1054***
Size of household	0.009 (0.014)	0.0064***	-0.061*** (0.015)	-.0109***		0.0045*
Residence (reference group: rural) Urban	0.376*** (0.055)	0.1115***	-0.552*** (0.062)	-.1208***		0.0093
Distance to the healthcare provider (reference group: distance<0.4 hours)	1.748*** (0.052)	0.3131***	0.114* (0.058)	-.1149***		-.1981***

Distance >0.4 hours						
Health status (reference group: no chronic illness) Have chronic illness	0.390*** (0.051)	0.0508***	0.275*** (0.054)	0.0159**		-0.0667***
Type of illness (reference group: fever)						
Diarrhea	0.247** (0.121)	0.0285	0.224* (0.118)	0.0214		-0.0499***
Pain/injury	0.525*** (0.067)	0.0917***	0.108 (0.071)	-0.0219**		-0.0697***
Blood pressure/heart diseases	0.965*** (0.112)	0.1585***	0.344*** (0.126)	-0.0221		-0.1364***
Respiratory diseases	0.775*** (0.129)	0.1146***	0.407*** (0.141)	.0068		-0.1214***
Weakness/dizziness	0.475*** (0.092)	0.0733***	0.212** (0.094)	-0.0001		-0.0731***
Female disease/pregnancy-related	1.541*** (0.121)	0.2875***	0.153 (0.156)	-0.0989***		-0.1886***
Others	0.632*** (0.078)	0.1183***	0.040 (0.088)	-0.0415***		-0.0769***
Delayed treatment (reference group: no delay)						
Delayed 1/2 days	-0.196*** (0.058)	-.0372***	0.006 (0.060)	0.0157*		0.0216**
Delayed 3/4 days	0.275*** (0.081)	0.0311**	0.264*** (0.086)	0.0224*		-0.0535***
Delayed 5/more days	0.779*** (0.079)	0.1291***	0.272*** (0.092)	-0.0214*		-0.1076***
_Constant	-2.549*** (0.170)		0.226 (0.174)			

LR $\chi^2(46) = 1181.94$; Prob > $\chi^2 = 0.0000$; Pseudo $R^2 = 0.0819$; ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively; standard errors in parentheses.

The following Table 4 displays the outcomes of both the Hausman test and the Small-Hsiao test regarding the IIA assumption. For the Hausman test of the IIA assumption, negative test results are frequently observed (Hausman & McFadden, 1984), leading to the conclusion that a negative result provides evidence of the absence of a violation of the IIA. The Small-Hsiao test was then conducted to confirm the outcome, and the findings concluded that the IIA assumption was valid in this study.

Table 4
Hausman test and Small-Hsiao test of IIA assumption (N=11,967)

H ₀ : Odds (Outcome J vs Outcome K) are independent of other alternative L						
Hausman test of IIA assumption						
Categories	Chi ²	df	P>chi ²	Evidence		
Qualified healthcare provider (J)	-12.670	23	-	for H ₀		
Non-qualified healthcare provider (L)	-306.933	23	-	for H ₀		
Pharmacy/traditional/self-care (K)	28.095	23	0.212	for H ₀		
Small-Hsiao test of IIA assumption						
Categories	lnL(full)	lnL(omit)	Chi ²	df	P>chi ²	Evidence
Qualified healthcare provider	-2250.866	-2239.601	22.530	23	0.488	for H ₀
Non-qualified healthcare provider	-2489.886	-2479.373	21.024	23	0.580	for H ₀
Pharmacy/traditional/self-care	-2098.242	-2091.522	13.441	23	0.942	for H ₀

Table 5 presents the outcomes of the Wald test, which indicates the goodness of fit of the model. In Table 5, the results of the Wald test indicate that the categories of the outcome (qualified health care providers, non-qualified health care providers, and pharmacy/traditional/self-care) are distinguished by the predictor variables in the model. This means that merging or combining some of the categories of the healthcare providers sought would not result in a more efficient estimate (Long & Freese, 2014; Müller et al., 2021).

Table 5
Wald test for combining alternatives (N=11,967)

H ₀ : All coefficients except intercepts associated with a given pair of alternatives are 0 (i.e. alternatives can be combined)				
Combination tested	chi ²	df	P>chi ²	Evidence
Qualified healthcare provider vs non-qualified healthcare provider	1515.283	22	0.000	against H ₀
Qualified healthcare provider vs Pharmacy/traditional/self-care	2035.656	22	0.000	against H ₀

Non-qualified healthcare provider vs Pharmacy/traditional/self-care	234.471	22	0.000	against H ₀
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5. Discussion

As women age, they are more likely to seek qualified healthcare providers, which is similar to the past study where a positive association was found between age and women's healthcare-seeking behavior in Egypt (Ahmed & Zaky, 2016). Older women are also more likely to have higher maternal healthcare utilization in Malaysia (Yeoh et al., 2016) and are prone to more complications of diseases that need better treatment in China (Du et al., 2020). Women who adhere to the Islamic faith display a greater likelihood of seeking healthcare services from qualified providers, in contrast to women practicing other religions, such as Hinduism, Christianity, and Buddhism. However, it is important to note that these findings are inconsistent with previous research (Hasan & Uddin, 2016; Mainuddin et al., 2015), where it was found to be insignificant. This study found a significant correlation between the educational attainment of women and their inclination to consult qualified healthcare providers, which is consistent with previous studies conducted in Bangladesh (Hasan et al., 2021; Yaya et al., 2017), Telangana (Reddy et al., 2020), and Nepal (Adhikari, 2016). However, women with higher educational attainment were less likely to seek non-qualified healthcare providers.

It was anticipated that women who have income would experience an enhancement in their social and financial standing, thereby potentially improving their healthcare-seeking behavior (HSB). However, our findings revealed a negative correlation between women who earn or have income and their inclination to seek healthcare from qualified providers, while a positive correlation was observed with their tendency to seek healthcare from pharmacies/traditional/self-care. This finding is consistent with the study conducted by Du et al. (2020), which revealed that women who were unemployed showed a higher inclination toward seeking medical treatment for ailments specific to females. Moreover, unemployed women in South Africa were more prone to reporting non-communicable diseases (Lopes Ibanez-Gonzalez et al., 2014). However, another study conducted in Ethiopia found that employed women were less inclined to avail themselves of healthcare services (Kifle et al., 2017).

Sometimes, women tend to disregard their health issues until they escalate into more serious conditions. According to a study by Schreiber Pedersen et al. (2018), only 25.3% of Danish women suffering from urinary incontinence sought medical assistance, in comparison to 31.4% of German women. The severity of the illness was identified as the primary factor influencing their healthcare-seeking behavior. On the other hand, women may not have the autonomy to make healthcare decisions independently, regardless of their employment status. Their healthcare choices may be influenced by their partners or family members (Kassim, 2021), or they may face time constraints. More in-depth analysis is needed to investigate why employed women struggle to improve their HSB when it comes to their health conditions. Moreover, the present study revealed a positive correlation between a larger family size and women's HSB, which is substantiated by a previous investigation conducted by Untari and Nugroho (2019).

Furthermore, urban women are more likely than rural women to seek care from qualified healthcare providers, and women from wealthier households are more inclined to seek care from qualified healthcare providers. These findings are consistent with numerous previous studies conducted in different countries (Du et al., 2020; Habtu et al., 2018; Hasan et al., 2021; Kifle et al., 2017; Liu et al., 2019; Rasul et al., 2019; Uddin & Mazur, 2015; Yaya et al., 2017). The findings also

indicate that, rather than reducing, long distances actually increase the likelihood of women seeking qualified healthcare. In Kenya, women travel greater distances to access services from public hospitals (Escamilla et al., 2018).

Women afflicted with respiratory diseases demonstrate a greater propensity to seek healthcare from qualified providers in comparison to experiencing fever. Therefore, women's HSB varies with the types of illnesses (Meng et al., 2016). Women with chronic illnesses are more inclined to seek healthcare from qualified providers, a trend supported by numerous previous studies conducted in Egypt (Ahmed & Zaky, 2016), Albania (Gabrani et al., 2021), and Bangladesh (Rasul et al., 2019). Delaying seeking treatment exacerbates the severity of illnesses, necessitating higher-quality healthcare. In a study conducted in urban Kenya (Escamilla et al., 2018), individuals initially disregard their illnesses or rely on home remedies. However, when their condition fails to improve or worsens, they seek high-quality treatment, resulting in increased treatment costs (Pajuelo et al., 2018). The duration or severity of illnesses intensifies the demand for modern healthcare (Wellay et al., 2018).

6. Conclusion

This study investigated the effects of women's earning status and other socioeconomic characteristics on their health-seeking behavior (HSB) by focusing exclusively on women who are ill and seeking any form of treatment. The study found that several factors influenced the likelihood of seeking out qualified healthcare providers. These factors included predisposing factors such as the age and education level of women, enabling factors such as economic well-being and urban residence, and need factors such as chronic illness, types of illnesses, and delayed treatment. Notably, the distance to healthcare services was no longer found to be a limiting factor in seeking qualified healthcare. However, the study revealed that one of the predisposing factors, namely the earning status of women, had a negative impact on HSB. It is, therefore, important to create a positive environment for women that encourages, rather than discourages, their earning potential, as this can contribute to gender equality and poverty reduction. To ensure that women have access to the necessary support and appropriate healthcare when needed and to minimize rural-urban disparities, it is recommended to organize awareness campaigns about the significance of women's health. Such implications can be extrapolated to developing countries that exhibit comparable socioeconomic and demographic conditions to those found in Bangladesh. This advances the field's understanding of earning women's subpar healthcare utilization.

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Authors Contributions

First author: Conceptualization, Methodology, Data curation and analysis, and Writing the original draft.

Second author: Supervision, Methodology, Writing-reviewing and editing.

Conflict of Interest

There are no conflicts of interest to declare.

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DEVELOPMENT OF THE MODIFIED CORPORATE RISK DISCLOSURE INDEX FOR BUSINESS SUSTAINABILITY

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ABSTRACT

The paper aims to outline the development of the Modified Corporate Risk Disclosure index. Its primary objective is to assist organizations in the case of oversight and monitoring of strategies to achieve long-term business sustainability. The Modified Corporate Risk Disclosure Index, comprising 134 items, is designed to serve as a detailed and comprehensive checklist for evaluating the level of corporate risk disclosure in corporations' annual reports. It is anticipated that the Modified Corporate Risk Disclosure Index will elevate companies' level of corporate risk disclosure by highlighting the advantages of having such an index. The benefit of creating this index is to establish a comprehensive framework that ensures long-term sustainability of the business and emphasizes transparent communication of potential risks to facilitate oversight and evaluation of the company's strategy.

1. Introduction

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) (2017, p. 9) defined risk as "the possibility that events will occur and affect the achievement of strategy and business objectives." This definition covers all types of risks that may impact business goals. Key risks include changes in governance or structure, external geopolitical and social factors, unforeseen cumulative events like global warming, negative impacts from specific incidents (e.g., fires or competition), and the potential conflict between positive outcomes and other business objectives (e.g., supply chain strain from high demand). On the other hand, risk management involves "coordinated activities to direct and control an organization with regard to risk" (International Organization for Standardization [ISO], 2018, p. 1). Risk management aims to create and safeguard value. It enhances performance, fosters innovation, and helps organizations to achieve their goals. Effective risk management is vital to organizational decision-making, ensuring that risks are managed in alignment with the organization's objectives.

Corporate risk (CR) refers to the specific area of risk management that ensures a business fulfils its corporate governance obligations, takes necessary measures, and recognizes and handles emerging risks. Incorporating corporate risk into the organizational ecosystem is essential and fundamental to business sustainability and success. This integration goes beyond mere compliance or precaution—it establishes a proactive approach that prepares the organisation for unforeseen challenges. By embedding risk management into strategic and operational planning, businesses can enhance their resilience, adapt to disruptions swiftly, and protect their long-term value. A robust risk-aware culture strengthens the organisation against potential threats, enabling it to manoeuvre uncertainties and maintain a competitive edge confidently. Therefore, by systematically identifying, evaluating, and mitigating risks, organizations position themselves to safeguard their operations and assets against unforeseen challenges. Hence, the disclosure of such risks is vital.

An organization's financial reporting should be transparent and convey significant information that effectively communicates the potential consequences of the company's commercial operations and risks in different situations in order to integrate competitors' strategies into companies' business sustainability. Corporate Risk Disclosure (CRD), as defined by Miihkinen (2012), encompasses all the information that companies provide in the risk evaluations section of their annual reports. The ICAEW (2011) report "Reporting Business Risks" explained that risk can have various outcomes, both positive and negative. On the other hand, IFRS 9 defines risk as the uncertainty surrounding changes in the cash flows or fair value of a financial instrument due to the risks faced by the entity.

Adopting and implementing Western-style governance models in developing economies often need to be more suitable due to widespread corruption, significant governmental intervention, and familial dominance (Uddin & Choudhury, 2008). Research has increasingly highlighted the distinct institutional contexts, accounting systems, and regulatory frameworks of developing nations compared to industrialized ones (Hassan, 2009). However, compared to stock market rules in the West, developing countries often require more advanced laws and better policies to protect investors. This includes situations where powerful investors take away the rights of smaller shareholders (Gonenc & Aybar, 2006).

The accounting literature emphasizes the importance of disclosing risks to meet stakeholders' needs in assessing the company's risk profile and market value (Salem et al., 2019). Some people think that owners in developing economies are taking on more risk due to relaxed corporate

governance rules, which could deter investment (Gibson, 2003; Klapper & Love, 2004). In developing countries, a small group of powerful owners often runs many businesses and makes decisions. Minority owners are at risk because they do not have as much control over how the business operates and how decisions are made (Claessens et al., 1999). When ownership is concentrated, with a small group holding a large portion of shares in a business, it can negatively impact minority interests (Claessens et al., 2000; Khan, 1999) and lead to information asymmetry between managers and investors (Chau & Gray, 2010; Healy & Palepu, 2001).

Additionally, some researchers have found lower risk disclosure reporting standards in growing markets compared to more developed economies (Siregar & Siagian, 2013). The combination of failing to protect minority interests and inadequate risk disclosure creates a challenging environment for investment, potentially discouraging foreign direct investment in developing countries. For instance, Mitton (2002) suggested that strong corporate governance requires the protection of minority interests and comprehensive risk disclosures.

The recent Malaysia Code of Corporate Governance (MCCG), updated on April 28, 2021, stated that the board should ensure the company's sustainability strategies, goals, and activities are communicated. In addition, a designated individual within the company's management must be identified to be responsible for the disclosure requirement. The annual report is the primary source of information about companies' financial and non-financial information. The main purpose for companies to apply CR information is to integrate competitors' strategies into companies' business sustainability. According to Sila et al., (2016), corporate risk-taking is crucial for achieving economic rewards. It is not only necessary for maximizing shareholders' wealth, but also the responsibility of boards to determine the readiness to take risks in pursuing strategic goals. Hence, the level of risk associated with policy and investment choices has the potential to determine the firm's competitive advantage within a particular sector. Corporate risk disclosure involves sharing information that outlines the significant risks faced by companies and the expected economic consequences these risks may have on their present and future performance.

The accounting literature emphasizes the importance of CRD in helping stakeholders to assess a company's risk profile and market value (e.g. Abraham et al., 2012; Miihkinen, 2013). The existence of governance frameworks can impact the disclosure of risks (Abraham & Cox, 2007). It is essential to prioritize enhancing risk disclosure, especially in challenging times, to accurately evaluate future performance and protect stakeholders' wealth.

Companies that provide transparent disclosure of risks and thorough identification, management, analysis, and assessment in their corporate reports enable readers to understand their business and risk profiles. As mentioned by Solomon et al. (2000), corporate reports are essential for accurately assessing the performance and financial health of a business. Financial reporting and transparency, as highlighted by Khlifi and Bouri (2010), play a crucial role in reducing information asymmetry and capital costs. By providing more details about different risks, businesses aim to satisfy investors, increase their reputation and lower the costs associated with monitoring these risks.

According to Botosan (1997), transparency allows shareholders to more precisely assess a company's financial performance and trust that the management is operating the business well. Furthermore, CRD encourages openness, increases investor trust, and lowers the cost of capital by providing crucial information about a company's performance and facilitating direct contact between businesses and investors. Ultimately, CRD benefits both firms and shareholders.

Above all, disclosing corporate risks not only enhances the organisation's reputation but also aligns with global expectations for sustainable and responsible business practices. Therefore, embedding risk management into the organisational framework and reporting on it provides dual benefits: it prepares the business for the worst, and demonstrates a commitment to transparency and sound governance.

This paper continues with: The emergence of Corporate Risk Disclosure; Corporate Risk Disclosure in the Malaysian context; Development of Modified Corporate Risk Disclosure Index (MoCorDi) and conclusion.

2. The emergence of Corporate Risk Disclosure

Upon careful review of the literature, it is clear that researchers have yet to establish a universally accepted definition of risk. Instead, they utilize various risk-related concepts and terms, such as risk-related narratives (Allini et al., 2016; Beretta & Bozzolan, 2004), risk management disclosures (Buckby et al., 2015), risk disclosure focuses (Gupta & Symss, 2023), and more. The need for more clarity surrounding the concept of risk further complicates its definition (Alkurdi et al., 2019). Additionally, a substantial number of researchers need to provide a precise definition of risk and instead assume that the reader has already grasped its meaning, leading to uncertainty among readers (Salem et al., 2019). Table 1 summarizes several concepts of corporate risk disclosure in the academic literature that will support the development of index in this paper.

Table 1:
Concepts of Corporate Risk Disclosure

Definition	Source
Risk disclosure' is considered to be 12 any information about "opportunity or prospect, or of any hazard, danger, harm, threat or exposure, that has already impacted or may impact upon the company, as well as the management of any such opportunity, prospect, hazard, harm, threat, or exposure".	Allini et al. (2016)
Communication of risk management practices are a critical component of good corporate governance.	Buckby et al. (2015)
Risk disclosure focuses on the communication of risk-related information as part of companies' annual reports. They give insight into risk exposure level of the company, which is beneficial for decision-making from the investor's point of view.	Gupta & Symss (2023)
All information that firms provide in the risk reviews they present in their annual reports	Miikinen (2012)
Corporate risk disclosure contributes to financial stability by providing stakeholders with a better understanding of companies' risk exposures and risk management practices	Zyznarska-Dworczak & Rudonien (2022)
Risk disclosure can play a vital role by providing information about uncertainty surrounding the business and the firms' management of these risks to investors and other stakeholders, to facilitate the process of making informed and impactful decisions.	Cabedo & Tirado (2014)

The probable frequency and probable magnitude of future loss.	Jones (2006)
Uncertain future events that could influence the achievement of a company's objectives.	King Committee (2002)
A communication of information concerning firms' strategies, characteristics, operations and other external factors that have the potential to affect expected results.	Beretta & Bozzolan (2004)
Any opportunity or prospect, or of any hazard, danger, harm, threat or exposure, that has already impacted upon the company or may impact upon the company in the future or of the management of any such opportunity, prospect, hazard, harm, or threat or exposure.	Linsley & Shrives (2006)
The risk arises when individuals make a deliberate decision to pursue an opportunity that has the potential to result in either a positive or negative outcome.	Salem et al. (2019)
The form of communication of information which is related to a company's strategies, business operations and external elements that may impair expected outcomes such as the disclosure of company future cash flows	Alkurdi et al. (2019)
Corporate risk disclosure, which entails reporting potential uncertainties and challenges, plays a crucial role in improving transparency, supporting stakeholder decision-making, and strengthening the company's strategic positioning by influencing market perceptions.	Wang et al. (2024)
...there are two perspectives commonly used to conceptualise quality of CRD, namely pre-modern and modern perspectives. ...there is no uniform basis to study and measure the quality of CRD.	Mbithi et al. (2022)
Corporate risk disclosure is influenced by governance factors (e.g., board independence and gender diversity), firm characteristics (e.g., size and liquidity), and cultural or situational factors (e.g., political connections and crises), with greater transparency often linked to better monitoring and increased uncertainty.	Mio et al. (2024)
Definitions of corporate risk are influenced by the practices and procedures unique to each group impacted, rather than being based on a single, shared understanding.	Azuma-Kotei & Ibrahim (2024)

3. Corporate Risk Disclosure in the Malaysian context

The Financial Reporting Act of 1997 and the Bursa Malaysia listing requirements mandate that companies in Malaysia disclose essential information (Amran et al., 2009). To boost market confidence, the Malaysian Accounting Standards Board and the Securities Commission regulate the disclosure of additional details on potential company risks. Moreover, the Malaysian Code of Corporate Governance explicitly emphasizes the need for a dedicated risk management committee and the importance of robust risk reporting practices.

Risk reporting procedures can generally be categorized into regulated and non-regulated risk disclosure. Regulators require corporations to include regulated risk disclosure in their annual reports, which specifies the information that must be disclosed. Providing shareholders with important information that is not regulated is often viewed as non-regulated disclosure (Al-Shammari & Al-Sultan, 2010).

In accordance with the Financial Reporting Act (FRA) of 1997, the Malaysian Accounting Standard Board (MASB) mandates that annual reports should be prepared in a manner that provides meaningful information on the financial condition, performance, and other relevant details of the businesses to a wide range of users. The Malaysian Financial Reporting Standards (MFRS) requires companies to provide a report that assists customers in understanding non-financial elements, such as risk management.

MFRS 132 Financial Instruments: Disclosure and Presentation examines the many categories of market risk faced by publicly traded companies in Malaysia. The criteria assist companies in determining whether to classify a financial instrument as equity or liability (Zadeh & Eskandari, 2012). MFRS 132 mandates the business to disclose its financial risk management strategies. It emphasizes the need to include a distinct part in the annual reports on hedging operations, such as fair value and cash flow hedges. However, the standard does not specify the format and placement of the information. MFRS 7 Financial Instruments: Disclosures provides specific information on identifying and addressing risks associated with financial instruments. The guideline further offers guidance for the minimum reporting requirements for credit, liquidity, and market risks.

Non-regulated risk disclosure includes strategy, operations, empowerment, information processing and technology, and integrity risks. It refers to the absence of laws or regulations that require enterprises to disclose certain information. Over time, there has been an increasing need for more non-regulated risk information offered by businesses. This is because such information gives shareholders a more thorough view of the company's strategy and performance (Chau & Grey, 2010). Within the scope of this research, the focus is on analyzing corporate risk disclosure, specifically on regulated risk.

An organization that implements proactive risk management should be able to accurately detect and efficiently address potential hazards. The disclosure of risk management offers benefits to both the company and its stakeholders. Effective risk-reporting processes may reduce the cost of capital, therefore increasing shareholder trust (Linsley & Shrivies, 2005). Investors who have access to such information may make more informed decisions when assessing the level of risk associated with their investment. Moreover, a proficient risk report should be able to demonstrate the directors' responsibility and competence in risk management. Hence, the board must understand the characteristics of risk problems and concerns in order to provide relevant and comprehensive risk information.

The COVID-19 pandemic has increased corporate risks, with varying degrees of disclosure among organizations, companies, and industries. Therefore, there is a need to come up with a checklist that measures the disclosure of newly risk related information in companies' annual reports. Previous studies on corporate risk disclosure in Malaysia only focussed on several categories of risk disclosure i.e. 1) operational risk, 2) environmental risk, 3) financial risk and 4) strategic risk (Mohd Ali & Taylor, 2014); 1) financial risk, 2) operation risk, 3) empowerment risk, 4) information processing and technology risk, 5) integrity risk, and 6) strategic risk (Hashim & Koon, 2016); 1) operations risk, 2) strategic risk, 3) empowerment risk, 4) integrity risk, and 5) information processing and technology risk (Abdullah et. al., 2015); 1) financial risk, 2) non-financial risk,) and 3) risk management framework (Kiflee & Khan, 2021). These studies did not refer to other disclosure items from the international guidelines, national corporate reporting framework and actual disclosure from the winners of corporate reporting competition.

The modified corporate risk disclosure index has several benefits. Firstly, as a result of the pandemic, companies are more aware of the strategies to mitigate risks. Companies could disclose this information to signify commitment in addressing any risks in the future. In this manner, stakeholders will be having more trust in the companies that disclose ways to mitigate risks. Secondly, from a practical perspective, this accounts for the inherent uncertainty in the future business environment. Once MoCorDi is materialized into a measurement tool, the Securities Commission of Malaysia can further enhance the corporate disclosure requirement for companies listed in Bursa Malaysia. Consequently, the Government or the Securities Commission can better understand the effects of future pandemics or crises like or worse than Covid-19. Finally, the MoCorDi will promote the establishment of the Malaysian Code on Corporate Governance (MCCG). The MCCG establishes principles and best practices for corporate governance in Malaysia, including risk management and transparency obligations. Principle 4 of the MCCG specifically stipulates that firms should design and report their risk management framework and identify the organization's significant risks and how they are handled. This leads to the development of a Modified Corporate Risk Disclosure Index (MoCorDi).

4. Development of Modified Corporate Risk Disclosure Index (MoCorDi)

The development of the MoCorDi checklist in this paper refers to the work of previous Malaysian scholars with regard to the development of the index. For example, Sustainable Development Goals Disclosure Index (Sawani et al., 2023); Modified Strategic Management Accounting Disclosure Index (James et al., 2023); Modified Accountability Disclosure Index (Ahmad et al., 2022) and Ethical Value Disclosure Index (Joseph et. al., 2023). The development of the MoCorDi checklist involves several steps as follows:

1. The identification of basic CRD items
2. The reference to previous studies
3. The modification of the index by the addition of the National Annual Corporate Report Awards (NACRA) 2021 criteria.
4. Removal / Addition of CRD items by comparing basic and actual CRD items disclosed in the annual reports of 2021 NACRA winners.
5. Validation of items by experienced scholars and industrial practitioners
6. Preparation of the final version of MoCorDi

The details of the steps undertaken in developing MoCorDi are as follows:

Step 1: Identification of basic CR information

The basic CR information is identified based on a few national and international guidelines such as Egyptian Accounting Standard, ACCA Global, The King II Report and Governance in Focus Risk Management - Deloitte. The reason for using those guidelines is to ensure that the annual reports for Malaysian companies are comparable with international companies around the globe. Furthermore, most of the content elements related to CR information, such as the guidelines regarding risk management, financial performance, governance, risks and opportunities, are emphasized in the guidelines. In this step, there are nine categories, with 96 CRD items.

Step 2: Reference to previous studies

The development of MoCorDi was further guided by reviewing CRD items from previous studies. The studies are inclusive of countries such as Spain (Hernández et. al., 2015) and UK (Elamer et. al.,

2019). In this step, there are 14 categories with 130 CRD items and CR information was classified into:

1. Financial risk
2. Operational risk
3. Empowerment risk
4. Information processing and technology risk
5. Strategic risk
6. Physical risks
7. Business continuity and disaster recovery
8. Market risks
9. Credit risk
10. Internal environment
11. Risk response
12. Control activities
13. Liquidity
14. Capital

Step 3: Modification of the MoCorDi by adding in criteria from the 2021 NACRA Award competition
The reliability of the checklist items was improved through a content analysis of seven companies that won the National Annual Corporate Report Awards (NACRA) 2021. Bursa Malaysia Berhad, the Malaysian Institute of Accountants (MIA), and The Malaysian Institute of Certified Public Accountants (MICPA) announced a new framework for NACRA 2021. The NACRA criteria have been updated to reflect the new normal in Malaysia necessitated by the COVID-19 pandemic, including the management of its impacts and adherence to social distancing norms.

Including the NACRA framework would further improve the MoCorDi checklist by complementing the international and national criteria. The companies' annual reports examined were: Nestle Malaysia Berhad, Sunway Berhad, Fraser and Neave Holdings Berhad, Petronas Gas Berhad, Axiata Group Berhad, Telekom Malaysia Berhad and Sime Darby Property Berhad. A score of "1" was awarded for disclosure of corporate risk items, and "0" for non-disclosure. The analysis of these companies serves the purpose of MoCorDi, which is to examine the extent of corporate risk disclosure. In this step, there are 22 categories with 152 CRD items.

Step 4: Removal/Addition of CR information by comparing the CR indicators and the actual CR disclosures available from the 2021 NACRA winners' annual reports

This step involved comparing basic CR information with the actual CR disclosure items obtained from the winners of the NACRA 2021 annual reports. Up to this stage, sixteen categories and 134 items were identified. In this step, some items were deleted due to non-applicability in the Malaysian business environment. Examples of deleted items are: amount of regulatory capital for market risk (Pillar Capital, stress testing, stress var, back-testing and credit concentration risk. This information was found in the Western literature. However, the information was not reported in the winners of the NACRA 2021 annual reports. At the same time, some items were added to the checklist, such as digitalisation risk, emerging risk - changing consumer needs, intellectual property infringements and legal claims, governance risk, business disruption resulting from a pandemic or global crisis and the resurgence of new virus risk due to the crisis in the year 2019, which was the COVID-19 pandemic crisis.

Step 5: Validation of checklist items by experienced scholars and industrial practitioners.

The validation of checklist items involved three experienced scholars in the CSR research area and experienced industrial practitioners from various industries such as manufacturing, telecommunications, construction, consumer products and services, utilities, and shipping. In doing so, valuable opinions and endorsements from the appointed scholars and industrial practitioners were sought to improve the quality and reliability of MoCorDi. Social and board disclosure was removed from the checklist because this category did not meet the purpose of corporate risk disclosure.

Step 6: Preparation of the final MoCorDi

The final step was constructing the finalized version of MoCorDi. Resulting of the above five steps, the final MoCorDi consists of 16 categories with 134 items, of which fifty-four checklists were derived from the Egyptian Accounting Standards 25, six items from the ACCA Global, eleven items from The King II report, nine items from the guideline of Governance In Focus Risk Management – Deloitte, thirty-two items from previous studies, and seventeen items are from the actual disclosures of the winners of NACRA 2021 annual reports. The finalized Corporate Risk Disclosure Index is presented in Table 2. Table 2 presents the list disclosure items of MoCorDi for monitoring of the company's strategies:

Table 2:
Finalized MoCorDi

Category	No	Disclosure Items
Financial risk	1.	Interest rate
	2.	Exchange rate
	3.	Commodity
	4.	Credit
	5.	Going concern
	6.	Cost of capital
Operational risk	7.	Customer satisfaction
	8.	Efficiency
	9.	Stock obsolescence
	10.	Product and service failure
	11.	Environmental
	12.	Health and safety
	13.	Brand name erosion
	14.	Management process
	15.	Supply chain disruptions and dependencies
	16.	Operational failures or breakdowns
	17.	Management Strategies
	18.	Scope and nature of the operational risk reporting system
	19.	Risk Transfer
	20.	Risk Mitigation
	21.	Risk Hedging techniques
	22.	Internal audit function
	23.	Internal control system
	24.	Key risk indicators (kris)/early warning systems (ews).

	25.	Self-assessment techniques (sa).
	26.	Stress tests/ scorecard models/scenario analyses.
	27.	Personnel (human error, labour disputes, loss of/recruiting key employees).
	28.	Disclosures to help users understand operational risk
	29.	Management and employee fraud
	30.	Illegal acts
	31.	Reputation
	32.	Operational excellence
	33.	Project excellence
	34.	Product safety and quality
	35.	Low demand products delivered
	36.	Penalties/disruptive
	37.	Plant and Facilities Risk
	38.	Project risk
	39.	Contractor risk
Empowerment risk	40.	Higher costs to obtain alternative supply
	41.	Leadership
Information processing and technology risk	42.	Communications
	43.	Integrity
	44.	Access
	45.	Availability
	46.	Infrastructure
	47.	Proliferation of technology
	48.	Data theft
	49.	Infrastructure and systems failure
	50.	Data loss
	51.	Sensitivity of customers' personal data, records
Strategic risk	52.	Digitalisation risk
	53.	Environmental scan
	54.	Industry
	55.	Business portfolio
	56.	Competitors
	57.	Pricing of product and services
	58.	Valuation of company
	59.	Planning
	60.	Life cycle
	61.	Performance measurement
	62.	Regulatory
	63.	Taxation
	64.	Macroeconomic trends
	65.	Natural disasters/terrorism
	66.	Gdp growth/market demand/aggregate demand
	67.	New Alliances, Joint Ventures and Acquisitions.
	68.	Capital investment returns

	69.	Regulatory compliance risks
	70.	Intellectual property infringements and legal claims
	71.	Restrictions of spectrum refarming and reuse
	72.	Availability of new spectrum and associated acquisition costs
	73.	Discriminatory practices
	74.	Governance risks
	75.	Emerging risk - Changing consumer needs
Physical risks	76.	Physical
Business continuity and disaster recovery	77.	Business continuity and disaster recovery
	78.	Business disruption resulted from pandemic or global crisis
Market risks	79.	Market risks
	80.	Profit rate risk
	81.	Equity investment risk
	82.	Structure and Organisation of the Market Risk Management Function
	83.	Currency risk
	84.	Var (value-at-risk)
	85.	Var limitations
	86.	Disclosures to help users understand market risk.
Credit risk	87.	Macro-economic factors
	88.	Cash
	89.	Trade and other receivables
	90.	Unlisted investments
	91.	Other assets
	92.	Counterparty risk
	93.	Residual/ credit mitigation risk
	94.	Migration risk
	95.	Objectives, Policies and Processes for Managing the Credit Risk.
	96.	Method of Measuring Credit Risk Exposure.
Internal environment	97.	Risk management philosophy
	98.	Risk culture
	99.	Number of Board of Directors
	100.	Organizational structure
	101.	Authority and responsibility assignment
	102.	Human resources policies
	103.	Strategic & operational information and compliance objectives
	104.	Risk tolerance
	105.	Risk classification
Risk response	106.	Risk assessment techniques
	107.	Probable risk responses assessment
	108.	Costs and benefits assessment
Control activities	109.	Types of control activities
	110.	Policies and procedures

Liquidity	111.	Monitoring activities
	112.	Objectives, Policies and Processes for Managing the Liquidity Risk.
	113.	Methods used to measure the liquidity risk.
	114.	Changes in exposure to liquidity risk, measurement of risk, and objectives, policies and processes to manage the liquidity risk from the previous period.
	115.	Contractual undiscounted cash flows.
	116.	Maturity Analysis of Derivative Liabilities.
	117.	Maturity Analysis of Financial Asset.
	118.	Derivative and trading liabilities treatment.
	119.	Risk transfer
	120.	Risk mitigation
	121.	Risk hedging techniques
	122.	Liquidity Buffers Sources and Volume.
	123.	Sensitivity analysis.
	124.	Financing facilities.
Capital	125.	Disclosures to help users understand liquidity risk.
	126.	Capital management.
	127.	Capital measurement.
	128.	Risk weighted assets.
	129.	Tier 1
Covid-19 pandemic resurgence	130.	Tier 2
	131.	Resurgence of new virus
Geopolitical risk	132.	Compliance costs
	133.	Civil unrest
	134.	Other social tensions

5. Conclusion

The paper introduces an updated Modified Corporate Risk Disclosure Index (MoCorDi) version. This improved index includes more comprehensive components that align with current business practices, reflecting the latest advancements in the corporate environment. The MoCorDi offers a more comprehensive framework for assessing corporate risk disclosures by integrating contemporary components, enhancing our understanding of how businesses report and utilize risk information. The Modified Corporate Risk Disclosure Index (MoCorDi) is expected to significantly enhance disclosure standards and provide valuable insights into corporate risk management practices.

The enhanced MoCorDi could become a crucial resource for regulatory agencies and businesses as they navigate future uncertainties, such as pandemics or other significant disruptions. Its implementation could greatly assist in preparing for and mitigating the impacts of such events by establishing more rigorous standards for corporate risk disclosures. The MoCorDi is a powerful tool for the Securities Commission of Malaysia, as it has the potential to improve transparency and guide decision-making by strengthening disclosure requirements for listed firms.

This paper lays a strong foundation for future studies on corporate risk disclosure. It has the potential to help regulators develop governance recommendations that encourage companies to disclose more comprehensive risk information. This research enhances the understanding and

implementation of risk disclosure, thereby setting the stage for future research and improvements in corporate governance. Ultimately, the Securities Commission of Malaysia and other regulatory bodies may increase public and investor confidence due to more detailed disclosures and enhanced transparency.

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Conflict of Interest

There are no conflicts of interest.

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EXPLORE CHINESE LACQUER ART CULTURE- EGGSHELL INLAY TECHNIQUE

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ABSTRACT

Chinese lacquer art is one of the treasures of Chinese traditional art. In China's 5000 years of profound history, eggshell inlay is an exquisite and complex conventional skill. This paper analyses the eggshell inlay technique, introduces technical elements from material selection and special tools to practical application, and describes its creative process, highlighting this traditional process's wisdom and unique artistic expression. This paper emphasises the application and artistic attraction in diversified application scenarios through comprehensive analysis and research on the conventional function and deep-rooted cultural value of eggshell inlay. It aims to deepen the detailed analysis of Chinese lacquer eggshell inlay technique, to clearly understand its cultural connotation and the quality of its artworks, and intuitively express its prominent position and far-reaching significance in Chinese and global cultural heritage. By doing so, more people can realise Chinese lacquer art's charm and unique value.

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1. Introduction

1.1 Background of Eggshell Inlay Technique

The eggshell inlay technique of Chinese lacquer art is deeply rooted in the fertile soil of Chinese cultural heritage and artistic tradition. Since ancient times, with its exquisite craft skills and complex artistic ingenuity, Chinese lacquer art has won the world's attention and exploration. Eggshell inlay is a unique and complex artistic innovation, which after centuries of technical exploration and development has enriched the aesthetic dimension of Chinese lacquer art

(Zheng, 2019) as well as enhanced its functionality and durability. The eggshell inlay technique accurately embeds fragile eggshells that are commonly found in life into the paint layer, using its pure natural environmental protection properties, according to different eggshell types and different eggshell colours, through the artistic ingenuity of Chinese artisans (Li, 2023). These unique, delicate, and complex designs reflect the extraordinary levels of skills of ancient craftsmen and their boundless innovative inspiration.

Chinese lacquer art symbolises luxury, elegance, and honour because of its sophisticated craftsmanship and precious raw materials. Therefore, it often appears in the court, noble residences, and religious holy places, which not only highlights the extreme pursuit of aesthetics in the past dynasties but also serves as a symbol of social class and cultural identity (Wang, 2022). The eggshell inlay technique was also used as a symbol of social class and cultural identity. Among them, the technique of eggshell inlay has gone far beyond the purely decorative role, and its application in the field of lacquer art, through patterns, colours, shapes, material innovation, etc., makes the eggshell inlay technique have a rich and profound cultural meaning and symbolic significance.

In studying eggshell inlay, most scholars have focused on one or more explorations of its historical changes, technological processes, material characteristics, and cultural connotations, aiming to unveil the wisdom of the ancient craftsmen and technical mysteries. To this day, eggshell inlay is still alive and well in contemporary Chinese and foreign art, upholding the core spirit of the ancient technique on the one hand and absorbing new materials and modern design concepts on the other, thus realising the perfect fusion of tradition and modernity (Zhou, 2023). At the same time, studying eggshell inlay can deepen understanding of Chinese craftsmanship, provide a vital reference perspective for studying ancient trade and cultural exchanges, and significantly impact the compilation of a complete Chinese traditional craft culture.

1.2 Significance of Eggshell Inlay Technique

Originating from ancient civilisation, eggshell inlay has engraved deep traces on the map of Chinese and world traditional arts with the development and change of time. Across time and space, this unique technique has demonstrated its extraordinary appeal on the vast stage of diverse cultures, from solemn ceremonial instruments to daily necessities, mapping out the common pursuit of aesthetics and technological refinement in societies of all periods.

Under the diversified artistic environment, from ancient craftsmen to modern artists in their persistent pursuit of eggshell inlay techniques, they have continuously explored new artistic expression materials and special tools, breaking through the limitations of traditional art (Zong, 2023) and giving eggshell inlay more aesthetic and artistic value from different perspectives and diversified levels of creative thinking. The rebirth of an eggshell often represents the birth of a new life and holds a hopeful and beautiful symbolism (Wang, 2011). In some works of art, these deep-rooted images are skillfully incorporated into the art, making Chinese lacquer art go far beyond its superficial visual enjoyment and become a medium for emotional and spiritual communication, giving life to the art.

In today's art world, the eggshell inlay technique is no longer a single lacquer decorative technique but has explored more artistic possibilities. Lacquer artists continue to explore the diversity and artistry of eggshell materials and apply eggshell inlay techniques in Chinese lacquer painting (Figure 1), breaking the limitations of craftsmanship and materials and enriching artistic expressions (Chen, 2021). Instead of losing its elegance, this traditional technique has been revitalised in many fields, such as fine arts and interior design, because of its aesthetic uniqueness, durability, and wide range of applications (Li, 2018). Eggshell inlay is still being passed down to

the present day and is still a source of artistic innovation. Whether it is for private space decoration or public art display, it shows excellent adaptability and aesthetic expression, injecting more fresh inspiration and vitality into lacquer art, and ensuring the relevance and practicality of this ancient technique in contemporary society.



Figure 1 Qiao Shiguang 《Jiangnan Water Town》

Eggshell inlay is an example of the combination of artistic aesthetics, exquisite skills, and a vivid display of deep cultural heritage and historical memory. Its dynamic evolution across cultures and generations inspires innovative thinking, powerfully demonstrating the enduring vitality of human creativity and the continued vitality and value of traditional crafts in the current social context.

1.3 Purpose and scope of the study

Eggshell inlay technique combined with the ancient Chinese traditional skills of comprehensive and detailed exploration, efforts through multi-dimensional, diversified, multi-perspective analysis and exploration, can reveal the mystery of eggshell inlay technique, an ancient Chinese traditional skills, from the process of completing the technology to the selection of materials to the application of technology, and seek to explore the inner nature and outer symbolism through multi-dimensional, broad perspective of the in-depth analysis. The study objectives cover various perspectives, from technical details to aesthetic values, cultural analysis, and innovative progress.

The study focuses on the background of eggshell inlay, understands its historical influence and development, analyses the factors of its enduring development and social aspects, and understands the unique properties and applicability of its materials from the background of its techniques so that the exploration of the materials becomes clearer. At the same time, the materials and tools that are required for the eggshell inlay technique are comprehensively explored and analysed. The technology's unique details and artistic characteristics are deeply excavated, specifically from the selection of lacquer to the mixing and processing, the selection and classification of eggshell materials, the use of special tools, and the subtle application of inlay technology. The process of this intangible cultural heritage is documented more comprehensively to recover the complete picture of its craftsmanship so that more people can recognise this complicated technique's exquisite and precious features.

The study discusses in detail the unique aesthetic qualities of the eggshell inlay technique in the field of lacquer art; because of the fragile nature of the eggshell itself, it can be better through

the natural edge of the line and size, to carry out a second deliberate creation, in the form of artistic expression with the fusion of nature and creation. Eggshells come in many varieties, showing diverse types in nature, such as duck eggshells in cold and warm tones. The natural colours of different eggshells contribute unique resources to Chinese lacquer art (Zong, 2023). In ancient Chinese lacquer art red and black are the traditional primary colours, but other colours and even pure white are difficult to artificially mix (Alexander, 2014), which makes them even more precious. For this reason, artists often follow nature and take materials from nature, as in the case of Chinese paintings where artists would take colours from natural ores or extract white from mussel shells, a clever use of natural materials from nature, fully reflecting the symbiotic creative wisdom of man and nature. Due to its natural texture and the unique interaction with the paint surface, the eggshell surface creates an extraordinary visual effect and artistic features of the eggshell's surface are created. Vietnamese lacquer artists have developed innovations in lacquer art using layering combined with mixed media and sanding processes that can be used to create a spectacular array of textures and finishes (Thomson, 2023).

In the cultural and sociological inquiry dimension, the study carries out in-depth excavation and analysis from the perspective of applying eggshell inlay. It carefully analyses the functions and values of these works in the diversified social structures, religious concepts, and historical backgrounds to map out the ancient society's ideological framework and value orientation. The comprehensive analysis of these two levels can reveal the eggshell inlay art's exquisite skills and mysterious charm and highlight its rich connotation and social influence as a cultural heritage, laying a theoretical foundation for eggshell inlay art. Correspondingly, the study aims to show in more detail the artistic aesthetic value and symbolic connotation of the Chinese lacquer eggshell inlay technique, not only devoting itself to its preservation and inheritance but also contributing to the preservation of the world cultural heritage and academic research and emphasising the continued relevance and innovative potential of traditional crafts in the modern society.

2. Literature Review

The history of Chinese lacquer art can be traced back to the Neolithic period when people began to utilise lacquer's decorative and protective properties. This initiative laid the foundation stone for the subsequent development of eggshell inlay art. In the development of eggshell inlay art, from the simple, functional application in the early stage to the prosperity of the Tang and Song dynasties, and then to the peak of the art in the Ming and Qing dynasties, from ancient times to the present day, through the inheritance and development of modern times, eggshell inlay art has significantly demonstrated the inherent continuity and innovative vitality of Chinese culture.

In exploring the Chinese lacquer technique of eggshell inlay, the preparation and selection of the lacquer species are the cornerstones that lay the foundation for both the artistic and technical value of the work. This section aims to analyse this complex process in depth, revealing the selection of materials, tools, and the craftsmanship to show more comprehensively how traditional wisdom and natural resources work together to shape the ancient art of eggshell inlay.

2.1 Selection of materials

2.1.1 Selection of paint types

Lacquer is a deciduous tree of the family *Lacertaceae* (Figure 2); it prefers a warm and humid climate, avoids the wind, grows at an altitude of 800-3000 meters, and thrives in sunny and moist mountain slopes within the forest. It was distributed in China, India, Japan, and Korea. The

best part of the trunk can be cut to extract the milky white sap rich in lacquer phenol. Raw lacquer has an adhesive force, is decorative, protective, etcetera. The integration of primitive means of subsistence, and then integrated into the utility of appliances, injected into the human aesthetic experience and emotion, the birth of lacquer, constituting a unique Chinese lacquer civilisation, unique Oriental charm, creating a lacquer culture development of the first river (Ma, 2021). However, it is essential to note that raw lacquer contains lacquer phenols, which may cause allergic or even toxic reactions for some people (Liu, 2024). Therefore, it is necessary to take precautionary measures during the harvesting of raw lacquer and the production of lacquerware, depending on the situation.



Figure 2 Lacquer tree

The eggshell inlay technique uses a large lacquer surface as the substrate on which the layout and inlay of eggshells are performed, in which the inlay of eggshells is also laminated to the lacquer surface using the lacquer as the natural adhesive (Cheng & Duan, 2015). After the inlaying of the eggshells is completed, the lacquer will be used to paint the surface several times, and the process of polishing and colouring will be carried out to ensure that the eggshells will not be fragile or fall off and that the integrity of the work will be ensured. Because of the importance of lacquer in the production process, the choice of raw lacquer is critical; you need to choose genuine natural lacquer, lacquer is non-toxic, but avoid selecting those products whose composition is unknown or contains unsafe chemical additives to avoid affecting the health and lacquerware artwork long-term preservation and production. Genuine, high-quality lacquer is usually characterised by high luminosity, rich and translucent colours, and a slightly subtle bumpy surface that feels smooth. In terms of odour, because lacquer is a natural substance, it has a unique and long-lasting natural fragrance. You can dip some paper into the lacquer and light it on fire. Good lacquer is easy to burn and does not make any sound when it burns, but if it contains chemicals, the sound may be different. If the lacquer contains chemicals, the burning sound may be different (Liu, 1980). There are many ways to test the authenticity and quality of lacquer. Still, the most important thing is to use pure natural lacquer to ensure the unique quality of the lacquerware.

2.1.2 Refinement and maturation of lacquer

Lacquer freshly collected from the lacquer tree is called raw lacquer, and the lacquer that has been processed in a specific way is called matured lacquer. Lacquer is usually collected in the summer, and the best quality is obtained on the day of three volts; when the temperature is high, the water evaporates quickly, and the sunlight is abundant, so the quality is the best (Tang, 2023). Lacquer farmers collect lacquer before sunrise by making a small cut in the trunk of the

lacquer tree and letting the milky-white raw lacquer sap to slowly flow out (Figure 3), a process known as "lacquer cutting". The raw lacquer begins to oxidise when it comes into contact with the air, changing from milky white to brown (Figure 4) and eventually hardening to black (Jin & Li, 2023). The process is called "cutting". As the old saying goes, "A hundred miles and a thousand knives yield one catty of lacquer". This is an excellent example of how difficult and expensive it is to collect lacquer (Chen & Yang, 2021). Therefore, in ancient times, only princes and generals were qualified to use lacquer, establishing the width and breadth of lacquer application.



Figure 3 White Lacquer Liquid



Figure 4 Brown Lacquer Liquid

The newly collected raw lacquer is mixed with oil impurities, thus a fine gauze or screen is also needed for the initial sieving to remove the large impurities (Cheng et al., 2022). The filtered lacquer is then placed in a cool, ventilated, and dry place for some time so that the heavy impurities will settle at the bottom, and the cleaner lacquer will appear on the upper layer to ensure the lacquer's purity and lustre. Subsequently, the purified lacquer will be heated and boiled; this time, the temperature will generally be controlled at (60-80 °C); the temperature is too high or too low to make the quality of the lacquer decrease. In constant stirring, the evaporated part of the water powder and solvent is the lacquer in the unstable components for polymerisation and purification. At the same time, this process can also remove the odour of the lacquer, making the lacquer purer and more transparent. Some lacquers also need to add an appropriate amount of oil auxiliaries to improve the performance of the lacquer, such as enhancing the gloss, increasing flexibility, accelerating the drying, and so on. Subsequently, the boiled lacquer liquid in natural conditions gradually matures through the role of air and sunlight

thickening; this slow transformation usually takes several months; this process is called "maturity" or "wake-up lacquer". Thus, the lacquer is more stable, the colour is more vibrant, and the viscosity is greater. This delicate and long-lasting process is also a testament to the quality of the lacquer that has been sculpted over time. Although the refined lacquer is already very stable, it is filtered several times before it is used by the craftsmen to ensure that the lacquer is smooth and free of particles to achieve the best painting effect (Chen, 2019). Lacquer refining is not only a test of the lacquer maker's mastery of traditional techniques but also requires scientific analysis and continuous innovation to meet the complex challenges of refining.

Formulating and selecting lacquer materials is not only a technical preparation for the Chinese lacquer eggshell inlay technique but also a profound conversation about history, culture, and the natural environment. While respecting and passing on the ancient techniques, the artisans continue to explore and innovate to ensure this craft's continued prosperity and cultural significance in the modern world, demonstrating the perfect fusion of human creativity and the gifts of nature.

2.2 Preparation and handling of eggshell inlays

2.2.1 Selection and Purification

Different eggshells have different sizes, colours, and textures. For example, in the creative process, you can choose duck eggshells when you are looking for a unique textural effect (Li, 2023), while quail eggs can be used for different colour choices. At the same time, because natural eggshells come in a wide range of colours, from white to dark brown, from cool to warm (Figure 5), different eggshells need to be selected and matched according to different creative requirements. The process of choosing and purifying the eggshells is crucial. It is directly related to the aesthetic quality of the final work, so it is necessary to ensure that the selected material has a uniform thickness, a complete structure, and is free from any defects to be fully prepared for the subsequent inlay.

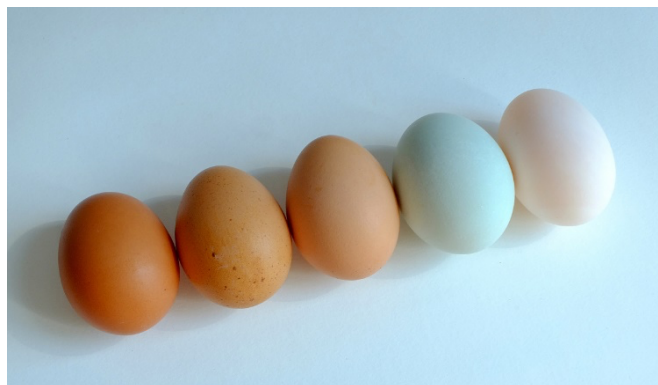


Figure 5 Eggshell Tone Chart

After careful selection, the eggshells must be cleaned and sterilised to remove all residual dirt, bacteria, etcetera, to ensure solid adhesion and lasting stability when creating inlays. In this process, it is necessary to use warm water and mild detergent to thoroughly clean the outer layer of the eggshell, for stubborn dirt can be soaked for some time, and then gently scrub with a soft brush to avoid excessive force to avoid destroying the eggshell. After cleaning, diluted alcohol can be used to sterilise the eggshells to prevent the growth of bacteria. After the cleaning process is completed, lay the eggshells flat to dry naturally or with low-temperature drying to

ensure that the inside and outside of the eggshells are completely dry to avoid subsequent use because of the lack of dryness, mould, and other conditions.

2.2.2 De-filming and crushing

After the selection and purification process, the inner membrane of the eggshells is removed by soaking, which is a delicate and time-consuming process. Still, it is a crucial step in ensuring the artistic quality and durability of the eggshell inlay (Tian, 2011). Removing the inner membrane allows the eggshells to be used for their artistic quality and durability. Removal of the inner film allows better contact between the eggshell fragments and the substrate material, which significantly improves the bonding strength between the eggshells and the substrate; if the film is not cleanly removed, it may directly affect the transparency and gloss of the eggshells, and it may also form tiny gaps or uneven protrusions between the eggshell fragments, which mainly affects the smoothness and fineness of the details of the works in the later stages of the production. In some of the works, colour paint is also used to colour the eggshells, and colour paint is also used to create multiple creations. Still, the film will affect the absorption and even distribution of the colour, ultimately affecting the artistic effect of the work. A seemingly small step in the process directly impacts the entire work of art, which also illustrates the preciousness and delicacy of lacquer art.

After removal, specialised tools such as carving knives, tweezers, etcetera, are used to cut or break the eggshells into desired shapes and sizes, depending on the creative needs (Yang, 2023). This process requires a high degree of precision on the part of the artisan, both to avoid damaging the delicate structure of the eggshell and to ensure that complete pieces are obtained that can be used for inlay. The separated pieces are carefully sorted and graded according to size, form, and colour to ensure the final piece is perfect.

2.2.3 Crafted Inlay and Artistic Layout

Before the formal inlay operation, the less experienced may plan the layout and design of the eggshells. At the same time, they need to carefully consider the colour contrasts, the direction of the texture, and the overall composition. However, skilled artists often use tweezers, paintbrushes, sharp tools, or fingertips to gently place the eggshells on the lacquer surface with a steady grip, keen visual judgment, and fine attention to detail to arrange and position the pieces of eggshell precisely.

More minor, more delicate tools may be required for particularly small or intricate parts. Although the eggshell pieces are small, the placement of each piece is calculated by the artists to ensure that the pattern is accurately aligned with the appropriate gaps so that it not only reveals the underlying colour of the lacquer but also adds a sense of hierarchy and rhythm to the artwork from the different gaps, thus, realising the pre-designed concept. After the eggshell is pasted, it is also necessary to lightly press the eggshell to ensure a close fit with the lacquer surface because the eggshell is fragile, so it is necessary to avoid applying too much strength, resulting in cracking or deformation of the eggshell, which will affect the effect of the artwork. However, the transparent lacquer can be partially dotted in some specific cases to fix the position further. After the inlay is completely dry, it is sanded to remove any unevenness or excess edges and then polished several times to reveal the eggshell's natural lustre and the lacquer's richness. Finally, an overcoat of lacquer can be applied to enhance the adhesion and gloss (Wang, 2023). The properties of lacquer protect the eggshells from environmental influences and to collect and preserve the artwork better.

Eggshell inlay is the crystallisation of the patience and exquisite skills of the artists, which requires their complete dedication. This attitude of excellence allows the intricate craftsmanship and profound aesthetic value to be fully realised. In this process, the artists are not only the guardians of the wisdom of ancient techniques and nature (Maatta, 2000) but the inheritors of a high level of skill that has been passed down from generation to generation, which also gives new life to the Chinese cultural heritage in their creations, giving birth to a piece of exquisite art treasures, which is not only a tribute to the tradition, but also a manifestation of the spirit of innovation.

2.3 Special tools required for the process

The uniqueness of the eggshell inlay technique in Chinese lacquer lies in the special tools that are used to make the process of handling, manipulating, and placing the eggshell inlay technique on the lacquer surface more delicate and efficient, helping the artist to fully utilise the finely crushed eggshells to create better-expressed works of art. Exploring the range of specialised tools employed in the eggshell inlay technique, with particular emphasis on their functional uniqueness, the necessity of their existence, and the value of their contribution to the overall quality of the lacquer art.

2.3.1 Polymorphic fine-cutting tools

In the creation of eggshell inlay artwork, the shape of the eggshell fragments has this diversity of needs, while the eggshell has thin and fragile characteristics; given these aspects, artists have developed many fine-cutting tools (Figure 6). These include miniature carving knives, scrapers, fine scissors, miniature scissors, and other tools, which are sharp and small enough to allow for precise cutting and fine adjustments on the eggshell. This requires the sharp edges and compact size of the tools, which can be used to adjust the position of the eggshells in the picture or to remove the excess better, creating complex geometric patterns and smooth curves and enriching the art form of the work with efficient cutting tools (Zhou, 2023). The cutting tools efficiently enrich the art form of the work, ensuring that the eggshells appear in the form required for the job.



Figure 6 Cuts

2.3.2 Micro-manipulated precision tweezers

In artistic creation, because eggshells are delicate and small, tweezers play a crucial role in controlling the fragments of eggshells. With their long and sharp jaws, the special tweezers can easily pick up and precisely place the tiny pieces of eggshells (Figure 7), especially when dealing

with patterns and details. In modern practice, the toothpick is also used as a sharp tool with tweezers. The selection of special tweezers is also very particular, often using stainless steel or corrosion-resistant materials to ensure long-term operation stability and durability. Precision tweezers require the artist to have extraordinary patience and excellent hand-eye coordination to ensure that each piece of eggshell is accurately embedded, achieving the fineness of the pattern and the smooth effect of the edge, highlighting the exquisite micro-technology.



Figure 7 Tweezer

2.3.3 Soft brushes for satisfactory bonding

Once the eggshells are prepared, it is time to create the picture. In the process of bonding the eggshells to the lacquer, different types and sizes of soft brushes can be used for various sizes of eggshells (Figure 8). In the process of inlaying eggshells, a layer of lacquer will be applied to the substrate (e.g. wooden boards, lacquer trays, or other material surfaces). After the lacquer is half-dried or suitably dried, the pieces of eggshells will be processed, and the lacquer will be brushed evenly onto the pasted surface of the eggshells with soft brushes to minimise the wastage of materials to ensure the flatness and fit of the eggshells. Subsequently, after several painting, grinding, and polishing processes, the eggshell and lacquer can be perfectly integrated, presenting a rich and delicate visual and tactile experience.



Figure 8 Soft brushes

The integration of these special tools in the eggshell inlay technique is not only about the artistic expression of the work and the realisation of modern technology, but they are also a witness to

the wisdom and extension of the skills and creativity of the artists. The relentless efforts of the eggshell inlay technique in the pursuit of perfection and continuous innovation support the vitality of this ancient art form and its innovative development. In the hands of the artists, they turn the ordinary into magic, showing the aesthetic value, craft complexity, and profound cultural connotations of eggshell inlay techniques to the fullest.

2.4 Application of Eggshell Inlay Technique

As a treasure of traditional lacquer art, Chinese eggshell inlay lacquer art maps out the technique's deep cultural roots, extensive social functions, and rich symbolic connotations. By applying natural materials, it showcases the harmony and beauty of man and nature.

2.4.1 Religious ceremonies

Natural elements are regarded as sacred symbols in certain religious or spiritual practices. Eggshells symbolise new life, and the beautiful allegorical symbols make eggshell inlay lacquer art an iconic item for ceremonial activities. It reflects the reverence for traditional rituals and conveys a more profound sense of cultural belonging and spirituality. Offering vessels, incense burners, and various decorative plaques decorated with intricate eggshell patterns convey the connotation of purification and rebirth.

2.4.2 Daily necessities

Eggshell inlay paint is used daily in storage containers, holding utensils, etcetera, showing its durability and practical value. The waterproof and anti-corrosion properties of lacquer make it an ideal choice for protecting precious items, such as spices, medicine, and even valuable jewellery (Zhang, 2022). Lacquerware was used to store eggshell inlay pendants, decorative plates, and vases, reflecting the director's attitude towards life and aesthetic pursuits. The penetration of eggshell inlay lacquer in daily life shows the perfect combination of art and utility, adding beauty and cultural flavour to daily life.

In its traditional application, eggshell inlay lacquer art has crossed the boundaries of ceremonial, decorative, practical, and symbolic. It has also been integrated into people's lives, becoming an essential carrier for transmitting culture and beautifying life. This demonstrates the depth and breadth of Chinese culture and reflects the close interaction between art and social life.

3. Methodology

This study adopts a multi-dimensional research strategy, and aims to analyse the craft details comprehensively and deeply, the aesthetic value of the eggshell inlay technique, and its role in cultural inheritance and artistic innovation.

Integration of Literature: Literature integration is a complex and meticulous work; in this work, it is necessary to comprehensively collect and sort out the historical documents that are related to eggshell Mosaic technology, archaeological excavation reports of different periods and detailed catalogues of precious collections in major museums and conduct in-depth analysis to determine whether these contents are in line with the corresponding research. The integration of literature is not only limited to the direct objective description of the traditional techniques of eggshell Mosaic technology but also includes the analysis of the historical, social, economic and other related factors that indirectly reflect the development of eggshell Mosaic technology.

The exploration and analysis of historical documents provide many written records about eggshell inlay techniques. These related materials are mostly official historical books, literati notes, or folk

manuscripts, which often record the cultural customs, skill inheritance, and process of information about the society at that time. This information plays a vital role in exploring the development of eggshell Mosaic techniques. Among them, archaeological excavation reports are the results of modern archaeology, which records the eggshell Mosaic crafts found in different sites and their critically unearthed environments in other periods. The distribution characteristics and technical evolution of eggshell Mosaic technology in different historical periods can be inferred through the study and analysis of these sites.

When the collections of major museums are sorted, a lot of physical evidence is provided. These collections are not only art treasures but also historical witnesses; they retain the essence of eggshell Mosaic technology in the form of physical objects. By comparing eggshell mosaic art in the different regions and periods, the changes in the technique over time and how it develops and evolves in different periods can be understood. Significantly, the core of the eggshell mosaic technique can be analysed more objectively.

The whole literature integration work also includes a detailed analysis of the technical details of the eggshell inlay technology, such as the lacquer production method, the eggshell selection and treatment, and the various special tools that are used in the production process. Discussing these details helps reveal how the ancient people have mastered and applied this technology because the tool is the medium of these exquisite skills. Only a good understanding of the form and function of the tool can develop the possibility of developing the eggshell Mosaic technology and a more diversified exploration. The applicative range of the eggshell Mosaic technology in ancient society is also one of the focuses of research. By analysing its use in different historical periods, how this technique served the social life of the time, such as religious ceremonies, daily decoration, or luxury goods of the aristocratic class can be revealed. Through this series of meticulous research and records, the literature integration work has accumulated valuable data for the study of eggshell Mosaic technology and laid a solid foundation for subsequent in-depth research.

Craftsmanship and tool analysis: Analysing craft and tools is a delicate process. By delving into the various aspects of the eggshell Mosaic technique, we can reveal the essence of its tradition and explore the possibilities of modern innovations.

In ancient times, artisans carefully selected eggshells based on various factors, such as colour, thickness and transparency, to ensure the quality and beauty of the final product. In the creation of modern society, the characteristics of different types of eggshells are analysed to select the most suitable materials for inlaying. In addition, the pretreatment of the eggshell is also essential, including cleaning, disinfection, and necessary strengthening measures to ensure that the eggshell will not crack easily during subsequent processing. Ancient craftsmen would use special knives or sharp cutting tools to cut the eggshells to achieve the desired shape and size of the design. In modern processes, although more sophisticated tools or mechanical AIDS may be used, the traditional beauty of manual skills must still be maintained. For the research of cutting tools, in addition to paying attention to their physical characteristics, it is also necessary to understand their use, the skills to reproduce the ancients' skills better.

From the initial sketch to the final product, ancient craftsmen would create according to different themes and patterns, and every step was carefully planned. Ancient craftsmen would use natural paint or other types of adhesives to secure the eggshell pieces to adhere firmly to the surface of the lacquer. In modern technology, chemical adhesives or improved fixation methods may be introduced. However, the ultimate goal is to ensure that the eggshell is tightly bound to the substrate and is durable. Through a detailed analysis of each step of the eggshell inlay

technique, a better understanding of the complexity and unique charm of this traditional craft is acquired.

Application significance: The applicative significance of the eggshell Mosaic art extends from religious rituals to daily life, transcends the boundaries of time and space and plays a vital role in promoting the protection and development of cultural diversity. This art form enhances the identity of the national cultural heritage and provides solid support for the inheritance and promotion of local culture. Notably, in the context of globalisation, eggshell Mosaic is one of the representative arts of traditional Chinese culture that has become an essential platform for displaying Chinese culture with its unique artistic charm and profound cultural value. It enriches the global cultural landscape and contributes positively to maintaining the world's cultural diversity.

4. The cultural significance of Chinese lacquerware eggshell inlay craftsmanship

The cultural significance of Chinese eggshell inlay lacquer art goes far beyond its visual beauty; it is deeply rooted in deep cultural connotations, rich symbolic associations, and a historical lineage that has endured in Chinese society.

Eggshell inlay lacquer art displays cultural heritage that unites the essence and innovation of thousands of years of arts and crafts. The diverse and complex patterns and designs not only reflect the traditional flavour, artistic development characteristics, and regional features of Chinese decorative arts but also convey a deep cultural meaning and aesthetic sentiment through elements such as auspicious motifs, myths and legends, nature, and flowers (Li, 2024).

In the long tradition of Chinese art and culture, eggshell Mosaic art contains rich symbolic significance. It expresses the people's desire for good luck and reflects the yearning for noble morality and spiritual pursuit. This art form uses natural materials such as lacquer and eggshells to show the harmonious coexistence between man and nature. It reflects the Chinese people's philosophy of advocating nature and pursuing the unity of nature and man. Eggshell inlay is a very high level of skill; it requires not only the craftsmen to have extraordinary patience and meticulous work attitude but also superb craftsmanship. From selecting and treating eggshells to inlaying and polishing, each step requires excellent effort and deliberation by the craftsmen. The exquisite final works reflect this rigorous control of details and the spirit of constant pursuit of perfection, which become the core value of eggshell Mosaic art. This pursuit of the perfect craft spirit makes eggshell inlay art maintain its unique charm in the long river of history, and even after the test of time, it is still brilliant. Not only that, this spirit has also inspired the inheritance and innovation of the future generations of craftsmen on the traditional craft so that the eggshell Mosaic art can also be revitalised in modern society, continue to bring people the enjoyment of beauty, and play a positive role in international cultural exchanges. Therefore, eggshell inlay art is not only a treasure in traditional Chinese culture but also a bridge connecting the past and the future, and its existence proves the eternal value of ancient Chinese crafts.

Eggshell inlay art is not only the embodiment of exquisite craftsmanship but also a symbol of social status and cultural accomplishment. Throughout its long history, this ornate lacquerware was mainly owned by the aristocracy and upper class, reflecting the wealth, taste and refined lifestyle of the society at that time. These exquisite works are often placed in prominent palaces, temples and ancestral halls, becoming visual displays of power, privilege and cultural capital. They not only highlight the noble identity of the owner but also reflect the high importance of art and aesthetics in society of that era. Through this elaborate lacquerware, people can glimpse the cultural atmosphere and aesthetic standards of the society at that time. They are a symbol of material wealth and a kind of inheritance and expression of spiritual culture. Therefore, eggshell

inlaid lacquerware is a work of art and a witness of history, recording the fashion and cultural features of an era.

The eggshell setting, an invaluable art form of ancient skills, is still highly respected in modern society. With the application of new materials and technologies and the clever combination of traditional craftsmanship and contemporary design, this ancient skill has been given new vitality. Through publications, cultural events and various exhibitions, eggshell Mosaic art has been widely displayed and inspired the public's pride and interest in their traditional art. In contemporary times, many artists and designers actively explore integrating traditional skills with modern aesthetics, creating works that retain the essence of tradition yet conform to modern aesthetics. These innovations enrich the expression of eggshell Mosaic art and open up a new path for the inheritance and development of this ancient skill. Through various cultural exchange activities and exhibitions, eggshell Mosaic art can be put out of museums and private collections and into the public vision so that more people can appreciate the charm of this unique art. Related books and magazines, as well as the publication and exposure of some social platforms, not only record the history and development of this art but also introduce production methods and innovative examples to help those who are interested to understand and learn more about this traditional art.

Chinese eggshell inlay art is culturally significant because it combines creativity, symbolism, and artistic skill to link the past, the present, and the individual with the community. By delving further into its historical roots and cultural meanings, a better appreciation of the cultural significance and enduring influence of this antiquated art form on Chinese culture can be fostered.

5. Conclusion

Upon conducting a thorough analysis of the eggshell inlay technique, it is evident that this art form possesses a wealth of historical and cultural significance and exhibits significant life and inventive potential in the contemporary era. This understanding is not only based on the microscopic analysis of the details of the technique, such as the acceptable requirements for the treatment of eggshells, the rigorous procedures for the preparation of the lacquer surface, and the artistic consideration of the layout of the inlay, but also embodied in the innovative use of special tools, such as those designed for cutting, inlaying and decorating eggshells, which guarantee the accuracy of the process at the same time, but also significantly improve the efficiency of the work, showing a clever fusion of the traditional skills and modern technology. This is a skilful fusion of traditional techniques and modern technology. The unique position of eggshell inlay lacquerware in art is due to the harmony between nature and artifice and the intertwining of traditional and modern design concepts in its works. Eggshell inlay is a physical presentation of material culture and a symbol of spiritual culture, which carries the reverence for nature, the pursuit of harmony, and a deep understanding of the cycle of life regeneration.

As a precious cultural heritage of the Chinese nation, the eggshell inlay technique builds a bridge between the past and the future. In the face of modern society's rapid development, it is of great significance to continue to excavate and inherit this technique and innovate it with contemporary aesthetics and market demand in order to promote the protection of cultural diversity and enhance cultural confidence. Only from the design point of view, for the modern design of the graphic elements, colour matching, design composition, etc., the works of traditional Chinese art are fully worthy of artists to explore in detail if the new design can be combined with the conventional art, the art itself will be more closely integrated with the inheritance and innovation, and at the same time. It can also inspire the younger generation's interest in the traditional culture and identity. Therefore, Chinese lacquer art should further strengthen the study, protection, and promotion of eggshell inlay art, which is of great practical

significance for maintaining cultural diversity and promoting the development of the cultural industry.

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BUILDING SUSTAINABLE MINDS: EMBEDDING GLOBAL CITIZENSHIP IN LEARNING

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ABSTRACT

This paper examines the effectiveness of the Service Learning Malaysia University for Society (SULAM) project in promoting knowledge sharing and fostering global citizenship among students. The SULAM initiative, a collaborative effort between Universiti Teknologi MARA (UiTM) and Universitas Singaperbangsa Karawang (UNSIKA), aims to provide students with practical experience in addressing real-world challenges faced by international Micro and Small Enterprises (MSEs). This study, drawing on comments from supervising lecturers and community partners involved in the project, explores the impact of the SULAM programme on students' development of global competency and practical skills. The findings highlight the significance of active engagement, teamwork, and collaboration in enhancing students' understanding of global issues and their ability to navigate complex problems. Furthermore, the SULAM programme's alignment with learning outcomes related to practical and entrepreneurial skills accentuates its role in preparing students to become active contributors to global society. Overall, this research contributes to the growing body of literature on service learning and highlights the importance of experiential learning initiatives in promoting global citizenship and sustainable development.

1. Introduction

This paper examines the effectiveness of the Service-Learning Malaysia University for Society (SULAM) project in promoting knowledge sharing and fostering global citizenship among students. The SULAM initiative, a collaborative effort between Universiti Teknologi MARA (UiTM) and Universitas Singaperbangsa Karawang (UNSIKA), aims to provide students with practical experience in addressing real-world challenges faced by international Micro and Small Enterprises (MSEs). Drawing on comments from supervising lecturers involved in the project, this study explores the impact of the SULAM programme on students' development and practical skills. The findings highlight the significance of active engagement, teamwork, and collaboration in enhancing students' understanding of global issues and their ability to navigate complex problems. Furthermore, the SULAM programme's alignment with learning outcomes related to practical and entrepreneurial skills accentuates its role in preparing students to become active contributors to global society. Overall, this research contributes to the growing body of literature on service learning and highlights the importance of experiential learning initiatives in promoting global citizenship and sustainable development.

The remainder of this paper is structured as follows. The next section provides background on the integration of global citizenship and sustainability into higher education curricula, followed by a discussion on how the SULAM initiative serves as an effective platform for this integration. The subsequent section describes the specific SULAM project from which the study's data was collected. This is followed by a discussion of the research method and findings. The paper concludes with a summary of key insights and implications.

2. Literature Review

Global Citizenship and Sustainability in University Curricula

The focus on global learning in higher education has increased significantly since the beginning of the 21st century and is now a common goal for many universities (Massaro, 2022). Kraska et al. (2018) highlight that academics and researchers often link internationalisation to marketisation, international competition, the recruitment and exchange of students. Shiel and Mann (2006) contend that fostering global citizenship requires students to adopt a global perspective, recognising the interconnectedness of their lives with people worldwide. This foundational understanding, coupled with exposure to global issues, processes, internationalisation, and sustainable development through both the university curriculum and extracurricular activities, equip students with the values, attitudes, and skills necessary for global citizenship.

Aktas et al. (2017) found that most programmes designed to promote global citizenship, based on a sample from 24 institutions across five countries, aimed to provide students with skills and knowledge relevant to the global economy. However, they observed a diverse array of programmes, with none adhering to a standardised curriculum. Each programme demonstrated a unique approach to preparing students for the global economy, emphasising adaptability over a rigid formulaic structure.

In a recent study, Massaro (2022) conducted a systematic review of the literature to explore the examination, measurement, and implementation of global citizenship within higher education institutions. The results highlighted that fostering global citizenship has emerged as a pivotal learning goal in higher education, aiming to provide students with the essential knowledge, skills, and attitudes for active participation as conscientious global citizens. This objective is typically

pursued through two primary avenues: extracurricular activities and integration of global citizenship goals into the curriculum.

Past studies like Perry, et. al (2013), Udvari and Vizi (2023), and many others highlighted that the integration of global citizenship into the curriculum can be achieved through various methods, including flipped classrooms, service learning, short courses abroad, student exchange programmes, elective courses, university courses, and university programmes. Examples of university programmes encompass flexible curriculum options, twinning programmes, and capstone projects, among others. Those studies showed that the emphasis on global learning in higher education is essential in preparing students to navigate and contribute to an increasingly interconnected world. By integrating global perspectives and issues into their education, universities can cultivate globally minded citizens ready to address the complex challenges of the 21st century.

The objective of this paper is to examine the integration of global citizenship and sustainability competencies into the curriculum through the adoption of a service learning approach. Specifically, this paper seeks to analyse the pedagogical insights derived from the implementation of SULAM, a concept rooted in service learning principles aimed at cultivating community engagement within higher education. Spearheaded by the Malaysian Ministry of Higher Education, SULAM embodies an inventive educational strategy with potential implications for teaching and learning paradigms.

3. SULAM: An Approach to Achieving Global Citizenship and Sustainability Competences

There is a compelling argument to suggest that universities and colleges hold a responsibility in developing international curricula that foster heightened global awareness among students. In recent years, a growing number of higher education institutions have embraced "internationalisation" as a core strategy. This obligation may arise from their educational mandate or in response to the increasing societal emphasis on cultivating global consciousness among future generations. In tandem with this shift towards internationalisation, universities and colleges are recognising the need to equip students with the skills and perspectives necessary to thrive in an interconnected world. International service learning emerges as a powerful vehicle for achieving this goal, providing a platform for students to situate their lives within a global context and deepen their understanding of cultural diversity, thus playing a pivotal role in fostering global citizenship and promoting sustainability.

Aligned with SDG 4 Quality Education, particularly its 7th Target on Global Citizenship, this section delves into a service learning initiative undertaken jointly by Universiti Teknologi MARA, Malaysia (UiTM), and Universitas Singaperbangsa Karawang (UNSIKA), Indonesia. The initiative aims to foster global-mindedness and sustainability among the younger generations. The primary objective of the SULAM programme is to immerse students in authentic societal challenges and to expose students to international business culture (Tuan Zainun, Seri Ayu, and Fadzlina, 2023). Through this initiative, students gain practical experience and learn to apply theoretical knowledge from the classroom to address real-world issues. By navigating diverse cultural contexts and understanding global economic systems through hands-on projects, students develop collaboration, critical thinking, and problem-solving abilities crucial for effective global citizenship in today's interconnected world.

Integrated into the capstone course, Integrated Case Study coded MAF671, of Bachelor in Accounting (Hons) at the Faculty of Accountancy, UiTM, the SULAM programme is tailored to provide practical assistance with financial management challenges faced by MSEs. The SULAM

programme is structured to align with two distinct learning outcomes: Practical Skills and Entrepreneurial Skills, both of which are essential for fostering global citizenship.

4. THE MAF671 SULAM PROJECT

The project adopts a case study approach, wherein several MSEs were selected as the subject of the case project. This educational exercise involved a comprehensive analysis of a real scenario, requiring participants to draw upon various disciplines and knowledge to address complex problems. Boyd (1991) and Jackson (1998) assert that the case study method is rooted in analysis, discussion, and decision-making. In the context of the SULAM project, students were presented with a case that simulates real-world business situations encountered by the organisation (Tuan Zainun, Seri Ayu Masuri, and Fadzlina, 2023).

Data was collected through semi-structured interviews with the MSE's owner-managers. Students were expected to analyse the data obtained to identify problems and areas for improvement and provide recommendations. The findings were then presented to the client, and a copy of the Business Advisory Report was submitted for their reference.

Assessments were conducted by both educators and MSEs, focusing on the quality and feasibility of the recommendations provided. Evaluation criteria included teamwork, communication skills, problem-solving abilities, and analytical thinking. Upon returning to the university, students were required to prepare a critical reflection on the project aligning with the approach proposed by Perry et al. (2013) that emphasises action-oriented experiences. Perry et al. (2013) argue that many nations are leveraging international education as a means to cultivate global citizenship. However, they caution against a simplistic "just do it" approach, suggesting that it may not be effective. Instead, they advocate for active participation that encourages reflection, critical analysis, and synthesis, serving as an effective catalyst for meaningful learning and development.

During the period between 2022 and mid-2024, three UiTM-UNSIKA SULAM projects were conducted, which are further described below.

4.1 First UiTM-UNSIKA SULAM Project, 1 December 2022 – 10 February 2023

The first UiTM-UNSIKA SULAM Project, held in December 2022 – February 2023, was conducted in a hybrid mode due to issues related to the post-COVID-19 crisis. It involved virtual participation by UiTM students and physical engagement by students at UNSIKA. While UNSIKA students performed tasks physically with the MSE industry partner, the owner-manager of an MSE in Karawang, Indonesia, UiTM's counterparts advised and interviewed the client virtually. Students' findings and analyses were then presented to the owner-manager of the MSE. Figure 1 exhibits a collection of photos during SULAM activities.



Figure 1: First UiTM-UNSIKA SULAM Project, 1 December 2022 – 10 February 2023

4.2 Second UiTM-UNSIKA SULAM Project, 29 May – 4 June 2023

The second SULAM project, held from May 29 to June 4, 2023, saw the participation of a group of 10 students from UiTM, Malaysia, and 25 students from UNSIKA, Indonesia, in Karawang, Indonesia. The community partner for this project was a family-owned MSE in Karawang, Indonesia. Additionally, the programme provided students with opportunities to engage in volunteerism projects, participate in industrial visits, and attend research talks as part of their learning experience, all of which contributed to their development as global citizens.

4.3 Third UiTM-UNSIKA SULAM Project, 1 April – 31 July 2024

The third SULAM project, held from April 1 to July 31, 2024, involved 15 students from UiTM, Malaysia, and 10 students from UNSIKA, Indonesia, in Sabak Bernam, Malaysia as shown in Figure 1. The community partner for this project was a family-owned MSE in Sungai Besar, Selangor. The programme also offered students the opportunity to immerse themselves in the local culture by staying in Sungai Besar for three days and two nights, allowing them to engage with the community and gain a deeper understanding of local traditions and activities. These experiences significantly contributed to their development as global citizens.



Figure 1: Third UiTM-UNSIKA SULAM Project, 1 April – 31 July 2024

5. Methodology

Data for this study was collected through semi-structured interviews with 3 supervising lecturers from UiTM and UNSIKA who were involved in the three aforementioned UiTM-UNSIKA SULAM projects. The interviews were conducted with durations ranging from 5 to 10 minutes and an average duration of 7.5 minutes. Interviews were conducted through a phone call and Whatsapp. Table 1 lists the interviewees' gender, affiliation and the duration of each interview.

Table 1:
Profile of the interviewees

Interviewee	Gender	Affiliation	Duration (minutes)
No 1	Male	UiTM	10
No 2	Female	UiTM	5 and Written response
No 3	Male	UNSIKA	Written response

6. Results and Discussion

The following section presents the insights gathered from interviews conducted with teaching lecturers from both UiTM and UNSIKA regarding the effectiveness of the SULAM program in promoting global citizenship among students.

Lecturer 1 underscored the programme's emphasis on teamwork and collaboration with international counterparts to address challenges encountered by international MSE. This active engagement necessitates effective communication throughout the planning, execution, and presentation stages of SULAM tasks. Consequently, students develop their global competency as they collaborate with peers and advisors from diverse backgrounds to identify and solve complex problems. In his own words: 'It may help our students to become competent global citizens since they work in a team together with their international counterparts to find and solve issues of international MSEs. This project requires active communication during the planning stage, engagement and presentation of SULAM tasks. Hence it should build up their global competency via teamwork and collaboration formed with international students and advisors to solve problems identified'.

This feedback highlights the significant role of the SULAM programme in fostering global citizenship among students through hands-on experiences that promote cross-cultural understanding and critical thinking skills. Through collaborative efforts to address real-world challenges, students emerge with enhanced capabilities to navigate the complexities of our interconnected world.

Lecturer 2 commented on the exceptional success of the SULAM activities, as quoted from UiTM News Hub: "Our students wholeheartedly embraced the opportunity to apply their accounting and management technical knowledge and skills to real-world situations, working closely with the local community. Through their active engagement, they not only gained invaluable practical experience but also fostered strong relationships with the people they served. This SULAM project exemplifies the power of collaboration, experiential learning, and community engagement."

Lecturer 3 expressed gratitude for the positive response and experience gained by students at UNSIKA, stating: "This visit has been an incredible opportunity for our students to broaden their horizons, gain exposure to different cultures, and exchange knowledge with their counterparts at UNSIKA. We are thrilled to have been able to collaborate with such a prestigious institution and hope to strengthen these ties in the future".

These positive findings are consistent with prior research on the integration of global citizenship and sustainability into academic curricula. Perry et al. (2013) focused on the effectiveness of short-term study abroad programmes for students in higher education institutions in the United States. Their study highlighted that when these programmes are accompanied by a robust pedagogical framework, they create transformative learning environments that facilitate the development of new perspectives and experiences. Additionally, a recent study by Udvari and Vizi (2023) further supported this notion, illustrating that university programmes, particularly those employing educational methods like the flipped classroom and global citizenship education initiatives, contribute significantly to the cultivation of global citizenship. Their research, which involved 44 bachelor degree students at a Hungarian university, emphasised the potential of university courses to enhance global competencies, albeit with varying degrees of effectiveness.

7. Conclusion

In conclusion, the SULAM programme stands as a beacon of success in promoting global citizenship among students, as evidenced by the findings from interviews with teaching lecturers, feedback from community partners, and insights from previous studies. By immersing themselves in real-world challenges and interacting with diverse communities, students gain a deeper understanding of global issues and develop empathy, cultural sensitivity, and a sense of responsibility towards addressing global challenges. Moreover, the SULAM programme is structured to align with two distinct learning outcomes: Practical Skills and Entrepreneurial Skills, both of which are essential for fostering global citizenship.

Through active engagement with international MSEs and hands-on experiences, students not only acquire practical skills but also cultivate a global mindset and a strong sense of social responsibility. This holistic approach to education empowers students to become active contributors to global society, equipped with the knowledge, skills, and attitudes necessary to create positive change and promote sustainable development on a global scale.

In essence, the SULAM programme exemplifies the transformative potential of service learning initiatives in higher education. By integrating action-oriented experiences, reflective practices, and cross-cultural collaboration, the programme prepares students to navigate the complexities of our interconnected world with confidence and competence. As universities continue to prioritise initiatives like SULAM, they play a crucial role in shaping the next generation of global leaders who are committed to building a more inclusive, equitable, and sustainable world.

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Authors Contributions

SAMMD and TZTM carried out the introduction and the brief overview of the SULAM project. SAMMD, TZTM and FMF supervised the project and engaged with community partners. NA wrote the literature review section, obtained feedback from the teaching lecturers and supervisors, and reported the findings. SAMMD conducted the proof-reading and acted as reviewer for the final draft prior to submission.

Conflict of Interest

"None declared"

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CLIMATE CHANGE AND ITS IMPACT ON THE MALAYSIAN STOCK INDEX

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ABSTRACT

Climate change poses significant risks to the financial market. There are significant research concerns surrounding this matter. This paper aims to study the impact of climate change on the Malaysian stock index. Considering the time series data of 43 years (1980 to 2022), regression analysis is implemented to investigate the correlation of macroeconomic variables such as gross domestic product, inflation rate, interest rate, and climate change indicator with the Malaysia Stock Index, which is represented by the FTSE Bursa Malaysia KLCI Price Index. The findings revealed that both gross domestic product and climate change indicate positive and significant correlations with the Malaysian stock index. In contrast, the inflation and interest rates were negatively correlated with the stock index, suggesting that higher inflation and a higher interest rate may deteriorate stock performance. This study contributes to the existing literature by providing a better grasp to investors in making decisions for equity investment in emerging markets.

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1. Introduction

Climate change is one of the most important events affecting everyone. According to a report published by the Intergovernmental Panel on Climate Change (2021), the world's temperature is expected to rise by more than 1.5 degrees Celsius in the next 12 years and by about 3 degrees Celsius by the end of the century. An estimation of \$23 billion in long-term losses in gross domestic product per year was projected if the temperature increased to 4 degrees Celsius above preindustrial levels under various global warming scenarios by the year 2100 (Kompas, Pham, & Che, 2018). Thus, the preventive steps to keep global warming below 2 degrees Celsius from pre-industrial levels and additional efforts to keep it below 1.5 degrees Celsius by 2050 that were outlined in the 2015 Paris Agreement are indeed timely. The climate

crisis has many negative consequences, and the most notable effect is global warming, which leads to risks such as higher temperatures, severe storms, increased droughts, the loss of species, food insecurities, and health risks. According to the United Nations, since the 1980s, each decade has been warmer than the previous one, with 2011–2020 recording the warmest years. Increased greenhouse gas concentrations raise the global surface temperature, leading to more hot days and heat waves, which not only increase heat-related illness and make working outdoors more difficult but also bring severe wildfires that threaten the loss of lives and assets. Therefore, research on climate change is urgent due to its far-reaching, serious ramifications on the environment, human health, economy, and financial system.

The financial system is under threat from systemic risks related to climate change, which might disrupt the financial sector's regular operations and have detrimental effects on the real economy. Therefore, regulators should be more vigilant and make greater efforts to mitigate the effects of climate change. The financial system is impacted by two categories of climate-related risks, i.e., transition risks and physical risks (Grippa, Schmittmann, & Suntheim, 2019). Transition risks are related to the risks posed by the changes in climate policy and technology necessary to achieve a low-carbon economy. Transition risks occur when a market is moving toward a greener economy, leading to increased corporate costs and declining company profits. As a result, the urgent need to shift to a greener economy might result in quick losses to carbon-intensive assets, potentially disrupting financial markets and institutions. The physical risk, on the other hand, is related to the lasting environmental changes such as damage to infrastructure, property, and land due to severe climate change events. As a result, businesses are exposed to the direct physical hazards associated with climate change since natural disasters resulting from global warming have the potential to devalue their assets, disrupt operations, and lower their profitability.

A significant number of projected losses from transition and physical risks could have a negative effect on financial markets and financial institutions. Therefore, the vulnerability of the financial system to exogenous shocks such as the catastrophic climate change event is a pressing issue that requires much attention. In addition to being a vital tool for diversification and exogenous shock mitigation, the stock market is a significant player in the financial market because it is an essential indicator for determining the effects of adverse climate events on the financial system. Participants in the financial markets face enormous challenges as a result of the shocks caused by climate change, which expose enterprises to new risks with potentially large financial consequences. The pricing and hedging of risks resulting from climate change are two important aspects of climate change economics that are financial in nature. However, investor awareness and attitudes toward these risks, as well as the impact of climate risks on investment decisions, have not received as much attention in the literature (Giglio, Kelly, & Stroebe, 2021). Furthermore, methods for assessing climate risk are still being developed, and it is still difficult to estimate hazards in some markets, such as the stock market, debt pricing, and real estate, in places where severe weather is common. As a result, the issue of how the stock market is impacted by climate change risk becomes pertinent. Drawing on the discussion above, this study examines the effects of climate change on the Malaysian stock market between 1980 and 2022. In addition to climate change, the stock market reaction function considers three other important macroeconomic variables: output, inflation rate, and interest rate. The evaluation of how climate change is affecting the stock market will help investors, companies, and financial regulators recognize and reduce the risks and shocks associated with climate change while preserving the stability of the financial system. Investors need reliable and accurate information to price climate risks precisely (Tay et al., 2024).

The remainder of the study is structured as follows: The following section reviews the selected literature. Section three offers the discussion on data and methodology. Section four explains the results and findings of the study. Finally, Section 5 presents the conclusion.

2. Literature Review

2.1 Stock Market and Climate Change

A burgeoning body of scholarship emphasizes the convergence of climate change and stock market dynamics. A recent study carried out by Vestrelli et al. (2024) utilized a total of 2013 U.S. firms, spanning three years from 2020 to 2022, to investigate the impact of four types of climate risk disclosure, i.e., emissions, physical risks, transition risks, and pollution, on firm market value. The findings demonstrate a strong positive relationship between climate risk disclosures and firm value. However, the impact will diminish when climate change attention increases, suggesting that increased attention may result in greater uncertainty and have a negative influence on business value. Their findings were aligned with Matsumura et al. (2024), Flammer et al. (2021), and Krueger et al. (2020).

Santi (2023) surveyed the sentiments of investors towards global warming through the analysis of StockTwits posts. The author compiles a portfolio covering the period from 2010 to 2019, including companies with varying degrees of emissions. The author employed a vector autoregressive model (VAR) to estimate a multivariate time series. The results suggest that the rise in attitudes towards climate change has a beneficial impact on the profits of investment portfolios and could influence the increase in carbon prices, thus partly reducing the emission of harmful pollutants into the environment.

Besides that, Ardia et al. (2023) found a significant positive correlation, indicating that green shares tend to perform better than brown shares on days when there is an unforeseen surge in attention towards climate change. When examining the returns of the green (brown) portfolio separately, they found a statistically significant positive (negative) correlation with unexpected media climate change concerns (UMC), a proxy of unexpected changes in climate change. Therefore, they concluded that a direct relationship exists between the level of emissions intensity and the extent of the firm's value volatility on days when there is an unexpected increase in concerns about climate change. Tay et al. (2024) also concluded that the overall effects may be positive or negative, with most of the effects being felt on the day of the event and some adjusting in the days that follow.

Liu et al. (2021) examined how the most notorious, economically damaging hurricanes can affect US energy companies' share prices using an event study methodology and regression analysis. The findings indicate that the impact of news about the most catastrophic US storms is negatively significant and differs among energy firms according to their carbon intensity: cleaner companies yield better returns compared to coal companies, while renewable energy stocks achieve the most resilient outcomes. Therefore, the researchers conclude that the proposition that energy capital markets react to climate-related events is probable and the evidence is stronger for more current events.

The reliance of the agricultural sector on weather patterns makes it one of the most vulnerable sectors to climate change. Reduced yields and crop failures may result from an increase in the frequency of floods and droughts. Droughts, for example, can significantly reduce food supply by impacting both crops and livestock. Extreme weather can also harm infrastructure, resulting in power outages and higher energy production costs. For example, droughts may restrict the amount of water available for thermal power plant cooling (Environmental Protection Agency,

2023). Governments' desire for greener energy sources during the transition to renewables may leave traditional fossil fuel sectors with stranded assets and higher operating costs as a result of new laws (Zurich, 2023).

2.2 Stock Market and Output

Keynesian theory posits that stock prices are sensitive to economic expectations, which are frequently associated with the overall production of a country. Predictions of economic growth indicate increased business revenues, which in turn result in a corresponding increase in stock values. In contrast, expected reductions in production may result in a decrease in stock prices when investors modify their assessments of future profitability (Keynes, 1936). This theoretical connection is substantiated by several empirical studies. For instance, a study conducted by Elfeituri et al. (2023) demonstrated a positive correlation between the stock market and economic growth in the Gulf countries. The relationship was influenced by the stock turnover and stock capitalization.

Islam et al. (2023) investigated the impact of the gross domestic growth rate on the Dhaka stock exchange by using statistical techniques such as descriptive statistics, Pearson correlation analysis, and multiple regression analysis. Their study has unambiguously established that the GDP has a pivotal role in influencing the performance of the stock markets in Bangladesh. A rise in the GDP means increased investment opportunities, consequently driving the stock markets upwards. Furthermore, the findings also disclosed that the stock market positively influences the economy by creating new job opportunities and promoting entrepreneurial activities.

Furthermore, the global recuperation from the COVID-19 epidemic has emerged as a highly consequential economic occurrence in recent times. Hassan et al. (2023) studied the link between GDP growth and stock market performance in developed economies during the period of post-pandemic recovery. A study revealed that when GDP growth recovered because of fiscal stimulus, vaccination campaigns, and relaxation of lockdown measures, stock markets in industrialized nations saw significant increases. This was particularly true for industries like technology and consumer goods, which benefited from accumulated demand and heightened retail expenditure. This study highlights the positive connection between GDP growth and stock market performance, particularly during phases of economic recuperation. The expectation of ongoing GDP expansion bolstered investor confidence, leading to an increase in stock prices across several industries.

However, Hsu et al. (2022) fail to find any relationship between GDP and stock market performance. An analysis of the data from 15 emerging and 21 developed equity markets over samples ranging from 32 to 120 years reveals that the effect of inflation and GDP variables follows a nonlinear pattern based on the nonlinear autoregressive distributed lag (NARDL) method. Similar results using quantitative regression showed that the impacts of inflation and GDP on the stock market transactions have been asymmetrical.

2.3 Stock Market and Inflation Rate

The Fama hypothesis suggested a negative association between inflation and stock return activity. He provides evidence that actual activity and stock returns are positively associated, whereas real activity and inflation are inversely correlated (Fama and French, 1988). There is increased interest among researchers to investigate the effect of inflation rate on the stock market fluctuation (Baker et al., 2020; Białkowski et al., 2022; Dridi and Boughrara, 2023). The recent study executed by Karagiannopoulou and Sariannidis (2024) verified Fama's hypothesis. They conducted a bibliometric analysis using R packages covering the period of three crises:

after the financial crisis, the COVID-19 crisis, and the war in Ukraine. The researchers applied the vector autoregressive model (VECM), impulse response, and variance decomposition to explore the dynamic relationships between inflation and the Greek stock market. They employed monthly data for the period of 1 March 2020 until 31 August 2023. The result shows a negative relationship between inflation and stock returns during the Ukrainian war. Meanwhile, the correlation after the financial crisis and COVID-19 crisis is uncertain. The result is consistent with other researchers (Chiang and Chen, 2023; Raghutla et al., 2020).

Chiang (2023) studied the connection between inflation forecasts and stock market performance using data from 20 developed countries throughout the testing sample period of January 1990 to June 2023. The results show that most countries have unfavorable relationships, except for Brazil and Russia. The study concluded that stock returns are negatively impacted by both equity market volatility (EMV) and predicted domestic inflation. Conversely, the Fisher hypothesis asserts the positive correlation between inflation and the stock market. Fisher states that nominal assets ought to act as a built-in inflation hedge. However, there is a lack of empirical evidence that conforms with the Fisher effect. The research conducted by Phiri (2023) on South Africa found that the full Fisher effect only existed in the pre-financial crisis period. The findings demonstrate how well the South African Reserve Bank has used inflation targeting to guide economic agents' expectations during the tenures of the last three governors.

Other literature highlights the effects of time on the stock market and inflation connection. Tiwari et al. (2022) examined the relationship between stock market returns and inflation using wavelet techniques on a long historical set of annual U.S. data spanning from 1800 to 2017. The finding shows evidence of a modest short-run co-movement and a strong long-run co-movement between stock returns and inflation. Alam (2020) investigated the impact of macroeconomic variables such as inflation, short-term interest rate, money supply, crude oil price, and oil price shocks on the Saudi stock market. The study employs the time series data for a period of 2009 to 2016 using the Johansen test of co-integration, the vector error correction model, and the Wald test. The study reveals the existence of a positive relationship between the money supply and the stock market. However, the inflation, short-term interest rate, and crude oil price variables show a negative relationship. The finding indicates the presence of both long-run and short-run unidirectional causality running from inflation, short-term interest rates, money supply, and the oil price shocks to the Saudi stock market.

Beh and Yew (2020) examined the long-term and short-term impact of the macroeconomic indicators on the U.S. and Chinese stock index markets. By using the ARDL method, the Shanghai Composite Index (SSE) and Shenzhen Stock Exchange Index (SZSE) markets are found to have long-term and short-term relationships with the macroeconomic factors in the United States. Besides, China's macroeconomic factors such as the Consumer Price Index (CPI) and real effective exchange rate have a significant impact on the SZSE market in the long-term and short-term period.

2.4 Stock Market and Interest Rate

Interest rates are a tool of monetary policy and one of the key determinants for stock market performance. An increase in interest rates would result in increased borrowing costs, and vice versa. The increase in borrowing costs would lead to a slowdown in business activity, and this will impact the stock price. In contrast, the lower interest rates encourage economic activities and increase purchasing power (Saha, 2024). Akin (2024) conducted a recent study on the effects of behavioral finance on S&P 500 stock market fluctuation in the United States. They tested the effects of behavioral biases while testing a time-series data set spanning ten years and

including the S&P 500, real interest rates, consumer confidence, market volatility, and credit default swaps. The findings indicate the negative correlation of market volatility, real interest rates, and credit default swaps with the stock market because of risk perception, loss aversion, and herding behavior.

Fransisca and Herijawati (2022) examined the impact of interest rate, exchange rate, profitability on gross profit margin, and liquidity on the current ratio of stock prices for the food and beverage sub-sector manufacturing companies listed on the Indonesia Stock Exchange from 2017 until 2020. The result shows that only profitability (gross profit margin) impacts the stock price of manufacturing companies in the food and beverage sub-sector. There are studies examining the differing effects of interest rates and stock market relationships on both developed and developing countries. Saha (2024) examined the divergence of the impact of monetary policy in five emerging nations and five developed nations. The result indicates a significant negative relationship between interest rates and stock prices. The finding particularly highlights that the market in emerging nations has a greater sensitivity towards monetary policy adjustment due to lower market liquidity, increased dependence on foreign capital, and weak financial infrastructure. Meanwhile, the developed nations suggested a more stable result as the countries have stronger financial systems and higher investor sophistication.

By investigating the reaction of emerging market firms towards the U.S. interest rate shock, Kim (2023) discovered that the firms with more export revenues, higher foreign ownership, and larger market capitalization tend to outperform the less export-oriented firms. The result also revealed that low-foreign-ownership firms become more volatile and experience more negative returns in the U.S. interest rate shock.

3. Data and Methodology

The data chosen for this study are the annual data based on their availability. The total observation of the study is 43 years, ranging from 1980 to 2022. The stock index (*SI*) is represented by the FTSE Bursa Malaysia KLCI Price Index, output (*Y*) is represented by the gross domestic product per capita, the inflation rate (*I*) is calculated based on consumer prices, the interest rate (*R*) is represented by the central bank policy rate, and the climate change indicator (*C*) is represented by greenhouse gas emissions (GHG). GHG is obtained from the manufacturing and construction industries in the form of millions of metric tons of CO₂ equivalent. Data on stock index, gross domestic product, inflation rate, and interest rate were retrieved from the DataStream, while data on greenhouse gas emissions was collected from the Greenhouse Gas Inventory Data, United Nations Framework Convention on Climate Change (UNFCCC).

Figure 1 illustrates the conceptual framework undertaken by this study. The diagram shows that the stock index is affected by the four variables in this study.

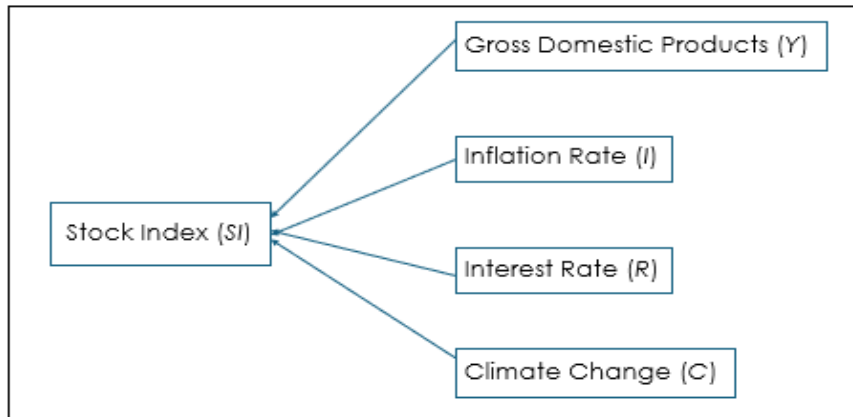


Figure 1. Conceptual Framework

Note: Stock index (SI) is the dependent variable, while gross domestic product (Y), inflation rate (I), interest rate (R), and climate change (C) are independent variables.

The multiple linear regression method is used to analyze the relationship between the stock index and the above-mentioned independent variables. Based on the conceptual framework, the regression model for this study is expressed as follows:

$$SI = \sigma + \beta_1 Y + \beta_2 I + \beta_3 R + \beta_4 C + e \quad (1)$$

where σ is the constant, $\beta_1, \beta_2, \beta_3,$ and β_4 are the coefficients for each variable, and e is the error term. The expected signs of the coefficients of β_1 and β_4 are positive, while β_3 and β_2 are negative. The independent variables are important determinants of the stock market if they have a statistically significant relationship with the stock index.

The present study posits that there is an upward relationship between the stock market and climate change. This is supported by the indicator of climate change, which is sourced from the manufacturing and construction industries, which account for more than 50 per cent of Malaysia's gross domestic product. As higher output is positively correlated with stock market performance, the proposition of an upward relationship between climate change and the stock market is established. The positive influence of climate change sentiment on portfolio returns may have an impact on the rise in carbon prices, which may limit the amount of damaging emissions released into the atmosphere (Santi, 2023). A positive correlation between firm value and carbon emissions indicates that investors consider environmental disclosures to be significant for firm value (Matsumura et al., 2014, 2022; Vestrelli et al., 2024). Extreme weather does, in fact, benefit utility companies, as rising temperatures are more likely to present an opportunity than a hazard as the need for cooling increases with rising temperatures (Pankratz et al., 2023), and, over time, CO₂ emissions have a beneficial effect on agricultural productivity (Chandio et al., 2023). Changes in long-term temperature are associated with a notably positive stock risk premium (Bansal, Kiku, & Ochoa, 2016).

Events in the world economy that are marked by erratic economic activity have made stock market movements volatile. Stock price volatility reflects economic activity uncertainty and has an impact on the stock market's performance (Segal, Shaliastovich, and Yaron, 2015). Therefore, this study postulates that output is positively related to stock market performance. Output is correlated with capital productivity, which is determined by how well management uses the

company's capital (Shiri et al., 2015). More stock returns are produced by higher capital productivity because it allows managers to employ capital more effectively and creates more sensible and successful investment strategy rules. Stock return and economic growth are positive during the period of persistent output volatility, as indicated by the rise in labor productivity (Madsen et al., 2013). Long-term predicted stock returns are explained by labor income fluctuation because changes in consumption growth led to adjustments in the equity premium (Santos and Veronesi, 2006).

Inflation is a useful tool for forecasting future actual activity and stock returns (Fama, 1981). This study proposes that the inflation rate is negatively related to stock prices. Inflation can impact economic performance by causing uncertainty, eroding purchasing power, and distorting judgments about investments and relative costs (Côté, 2014). Investors' time-varying aversion to risk in relation to inflation raises the real discount rate and equity premium, which lowers stock prices (Brandt and Wang, 2003). The present investigation suggests a positive correlation between interest rates and stock prices. Increasing interest costs that worsen a company's balance sheet can explain how stock prices respond to changes in interest rates (Bernanke and Kuttner, 2005). Interest rate increases raise operating costs, which in turn reduce projected future cash flows and stock prices (Pirovano, 2012). Therefore, through their effect on borrowing costs, interest rates may influence stock returns. The price of stocks decreases as interest rates rise in the inverse relationship between the two.

4. Results and Discussion

Table 1 shows the descriptive statistics for the selected variables for this study. The observed series shows considerable variation across the study period, ranging from a minimum of -1.14 for the inflation rate to a maximum of 11993.19 for the gross domestic product. The stock index, gross domestic product, inflation rate, interest rate, and climate change indicator have positive mean values. Regarding the benchmark normal distribution, the overall kurtosis for the distributions is less than three, i.e., varies from a minimal value of -1.42 for the stock index to a maximum of 2.81 for the inflation rate, indicating less leptokurtic behavior of the data observed. Except for the climate change indicator, the other series are right-skewed, with inflation data recording the higher degree of skewness, while the stock index and gross domestic product are relatively symmetric.

Table 1
Descriptive Statistics

	<i>SI</i>	<i>Y</i>	<i>I</i>	<i>R</i>	<i>C</i>
Mean	952.74	5791.18	2.82	4.13	24.24
Standard Error	81.82	530.57	0.30	0.30	1.60
Median	894.36	4454.53	2.66	3.23	26.54
Standard Deviation	536.52	3479.19	1.94	1.94	10.50
Sample Variance	287854	12104752	3.75	3.75	110.33
Kurtosis	-1.42	-1.39	2.81	-0.66	-1.11
Skewness	0.23	0.47	1.07	0.84	-0.16
Minimum	206.54	1782.54	-1.14	1.75	7.90
Maximum	1852.95	11993.19	9.70	8.33	43.58

Note: *SI* denotes stock index, *Y* denotes gross domestic product, *I* denotes inflation rate, *R* denotes interest rate, and *C* denotes climate change.

Table 2 reports the correlation analysis between the stock index and its determinants, namely gross domestic product, inflation rate, interest rate, and climate change. Both gross domestic product and climate change recorded positive and significant correlations with the stock index. In contrast, the inflation and interest rates were negatively correlated with the stock index, suggesting that higher inflation and a higher interest rate may deteriorate stock performance. However, the inflation rate is not significantly correlated with the stock index, as indicated by the correlation coefficient of -0.2442. The stock index has the highest correlation with gross domestic product, with a coefficient of 0.8960, suggesting the importance of economic activities in explaining stock market performance.

Table 2
Correlation Analysis

	<i>SI</i>	<i>Y</i>	<i>I</i>	<i>R</i>	<i>C</i>
<i>SI</i>	1.0000				
<i>Y</i>	0.8960***	1.0000			
<i>I</i>	-0.2442	-0.3113**	1.0000		
<i>R</i>	-0.4589***	-0.5647***	0.3701**	1.0000	
<i>C</i>	0.8325***	0.7936***	-0.3094**	-0.5696***	1.0000

Note: *SI* denotes stock index, *Y* denotes gross domestic product, *I* denotes inflation rate, *R* denotes interest rate, and *C* denotes climate change. *** and ** indicate significance at 1% and 5% levels.

Table 3 summarizes the results of the regression analysis. Four models were presented: model 1 captures all four independent variables; model 2 ignores the interest rate; model 3 does not include the inflation rate; and model 4 only captures gross domestic product and climate change. The reason for including more than one model is because there were two insignificant variables, i.e., inflation rate and interest rate, in model 1. Dropping the insignificant variables is a systematic way of building models that capture only the significant variables. The coefficients of determination (R^2) for the four models were 85.55%, 84.60%, 85.44%, and 84.26%, respectively. The results suggest that the independent variables explain more than 80 per cent of the variation in the stock index. This is further supported by the results of the ANOVA, which indicate that all the independent variables explain the variation in the dependent variable.

Table 3
Summary of Regression Models

Variables	Model 1	Model 2	Model 3	Model 4
<i>Y</i>	0.0001***	0.0001***	0.0001***	0.0001***
<i>I</i>	0.0129	0.0213		
<i>R</i>	0.0433		0.0468*	
<i>C</i>	0.0239***	0.0215***	0.0237***	0.0209***
Constant	5.1153***	5.3652***	5.1457***	5.4536
R^2	0.8555	0.8460	0.8544	0.8426
ANOVA	52.2645***	71.4151***	76.2660***	107.0616***
AIC	0.3071	0.3246	0.2687	0.2999
Test of Assumptions				

Normality Test	16.6004***	9.2250***	17.7012***	8.4584**
Autocorrelation	9.7413***	12.6716***	10.2970***	13.9429***
Heteroscedasticity	13.1986	6.6360	3.3931	5.6536
Multicollinearity	No serious multicollinearity	No serious multicollinearity	No serious multicollinearity	No serious multicollinearity

Note: Y denotes gross domestic product, I denote the inflation rate, R denotes the interest rate, and C denotes climate change. *** and ** indicate significance at 1% and 5% levels. R² represents the coefficient of determination, and AIC denotes Akaike Info Criteria.

Overall, the results revealed that gross domestic product and climate change were the two variables that had statistically significant relationships with the stock index in the four models. The inflation rate did not significantly affect the stock index, as indicated in models 1 and 2, giving support to the results of the correlation analysis, which showed that the inflation rate is not significantly correlated with the stock index. Interest rate is not important in explaining the stock index in model 1 but is statistically significant at the 10 per cent level in model 3, however, with an incorrect expected sign. A good regression model should include only significant independent variables; thus, the selected model is model 4, which encompasses two significant variables that are affecting the stock index, i.e., gross domestic product and climate change. Model four revealed that the error term has a constant variance as indicated by the result of heteroscedasticity, and the model has no serious multicollinearity problem. However, the error term is found to be not normally distributed and not serially independent. The presence of autocorrelation is because of the use of time series data. Therefore, the model must be interpreted cautiously.

The mathematical equation for model 4 is expressed in the following equation:

$$SI = 5.4536 + 0.0001Y + 0.0209C + e \tag{2}$$

Based on model 4, gross domestic product is statistically significant at the one percent level in explaining the stock index. This means one unit increase in gross domestic product will increase the stock index marginally by 0.0001. The results are consistent with the study of Efeituri et al. (2023), Islam et al. (2023) and Hassan et al. (2023), who found that there was a significant relationship between output and the stock market. On the other hand, climate change is a significant variable in explaining the stock index. Increasing by one unit in the climate change indicator will increase the stock index by 0.0209 units. The results are aligned with Santi (2023), Matsumura et al. (2014, 2022), Vestrelli et al. (2024), and Pankratz et al. (2023), who revealed that the relationship between climate change and the stock market was positive.

4.1 Findings of the study

An analysis of the data above proves that GDP is positively significant in influencing stock indexes, as proposed by Keynesian theory (1936), which suggests that an increase in the GDP leads to a corresponding increase in the stock market trends. The positive correlation may indicate that economic expansion fosters a favorable environment for businesses, leading to higher corporate earnings, which in turn drives stock prices upward. This relationship highlights the interconnected nature of the economy and the stock market, where robust economic fundamentals typically result in enhanced investor confidence and increased stock valuations. According to Islam et al. (2023), an increase in GDP can result in a corresponding increase in the stock market through two distinct mechanisms. First, a rise in GDP results in elevated levels of consumer expenditure, improved firm operations, and expanded investment prospects, thereby

propelling the stock market in an upward direction. Second, the stock market directly contributes to the economy by creating new job opportunities and fostering entrepreneurial endeavors.

The above result of this study shows that there is a significant relationship between climate change and stock index. Climate conditions that are favorable, including sufficient rainfall and comfortable temperatures, boost agricultural productivity and raise GDP. In addition, utilities and renewable energy sectors do benefit from increasing rainfall and rising temperatures brought about by climate change, which represent a chance to boost the performance of stocks in this industry. The stock market performs better because of this growth since these sectors report stronger profitability and growth prospects. Positive information about the market's climate affects stock prices, which has the potential to boost stock values, especially in industries like oil and gas that are vulnerable to climate policy. Companies are beginning to include climate considerations in their portfolio plans, indicating that these aspects have a favorable impact on stock market performance (Yang et al., 2023). Non-linear characteristics are revealed by the effects of climate change on stock returns, as demonstrated by shock reversal, which happens both before and after climate change occurrence. A more sophisticated knowledge of how climate change affects stock returns has been made possible by the development of strategies for climate adaptation and mitigation, such as weather forecasting technologies (Li et al., 2024). Overall, this research indicates that stock index performance is eventually supported by the long-term link between climate variables and GDP.

5. Conclusion

Climate change is increasingly recognized as a significant risk to economic growth due to its extensive effects, such as extreme weather events, resource scarcity, infrastructure damage, and shifts in labor productivity. There are increasing numbers of researchers investigating the effects of climate change in different dimensions. This study adds to an existing body of literature by investigating the connection between the stock market and climate change. In this article, we put forward the selected macroeconomic factors of gross domestic product (GDP), inflation rate, interest rate, and the climate change indicator to capture the effects on stock market performance. The results reflect a similar outcome from most of the previous literature: climate change has a significant impact on the stock market. The agricultural, utilities and renewable energy sectors do benefit from increasing rainfall and rising temperatures brought about by climate change, which represent a chance to boost the performance of stocks in this industry. Apart from that, climate change also has the potential to boost stock values, especially in industries like oil and gas that are vulnerable to climate policy.

5.1 Policy implication

Climate change-related information is crucial for the financial market because it conveys risks and uncertainties that affect investors' reasoning and, ultimately, their capacity to make prudent investment decisions. Consequently, authorities must outline policies that lower market uncertainty about climate change while enhancing financial stability. Furthermore, the disclosure of information on environmental issues and climate change, along with related policies, is essential for investors to minimize information asymmetries that could significantly impact their decision-making.

For policymakers, these findings underscore the need to develop robust regulatory frameworks that facilitate transparent communication of climate risks and opportunities. Investors and corporations must also adapt their strategies to incorporate climate risk management into their decision-making processes, recognizing both the potential for sustainable investment

opportunities and the necessity of compliance with evolving regulatory requirements to mitigate financial risks associated with climate change.

5.2 Limitations and recommendations

This study, however, is subject to a few limitations. The study focuses solely on Malaysian data. Therefore, we suggest that future researchers explore broader coverage, such as developed and emerging markets, to distinguish the impact of climate change on different types of countries. Potential future research could be enhanced by including methodologies such as the dynamics heterogeneous panel cointegration model, ARDL, or nonlinear ARDL that consider real-world factors. To conduct a comprehensive multiple analysis of climate change, this study recommends an examination of a diverse range of indicators, including temperature extremes, rainfall patterns, and the frequency of extreme weather events. This broader approach allows for a more nuanced understanding of climate change's impacts, enhancing the robustness and reliability of the findings. To enhance the robustness of the findings, it is recommended that future research incorporate additional climate variables, such as more specific environmental factors, e.g., deforestation rates, extreme weather events, or carbon emissions by sector. Additionally, the inclusion of more recent data, as well as a comparison with other regional markets, could provide deeper insights into the cross-country impacts of climate change on stock indices. Engaging in scenario analysis or stress testing could also add value by projecting future impacts of climate change on the stock index.

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Authors Contributions

Introduction: BHT; Literature review: BHT, NMHA & MO; Data & Methodology: BHT & NMHA; Results and Discussion: BHT & NMHA, Conclusion: NMHA & MO.

Conflict of Interest

No conflict of interest is associated with this publication.

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PENERIMAAN PELAJAR UiTM DALAM PEMBELAJARAN KOSA KATA ARAB MENGUNAKAN APLIKASI MUFRADATI

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ABSTRACT

An application is a type of technology that is designed to make things easier for people to use. It has now been broadened in the area of learning, particularly in terms of language vocabulary. The *Mufradati* application is an Arabic vocabulary software designed for UiTM Kedah students. It becomes necessary for UiTM students to master Arabic terminology. Therefore, the purpose of this study is to discuss *Mufradati's* acceptability by UiTM Kedah students in terms of its application in Arabic vocabulary learning. This is a quantitative case study. The study sample consisted of 155 respondents. Data was collected by a questionnaire and analyzed descriptively using percentages, means, and frequencies. The findings indicate that UiTM Kedah students have a favorable attitude toward the *Mufradati* application. This demonstrates that technological components are highly significant when it comes to vocabulary development. This program provides students with an alternate way to study Arabic language independently and flexibly.

Aplikasi adalah salah satu teknologi yang direka untuk memudahkan seseorang menggunakannya. Ia kini telah diperluaskan dalam dunia pembelajaran, terutamanya yang melibatkan aspek perbendaharaan kata bahasa. Aplikasi *Mufradati* adalah aplikasi perbendaharaan kata Arab yang dibangunkan untuk pelajar UiTM Kedah. Ia menjadi keperluan bagi pelajar UiTM dalam mempelajari perbendaharaan kata bahasa Arab. Oleh itu, kajian ini bertujuan untuk membincangkan penerimaan *Mufradati* oleh pelajar UiTM Kedah terhadap aplikasi *Mufradati* dalam

pembelajaran kosa kata bahasa Arab. Kajian ini adalah kajian kuantitatif dalam bentuk kajian kes. Sebanyak 155 responden digunakan sebagai sampel kajian. Data diperoleh daripada soal selidik dan dianalisis secara deskriptif, melibatkan peratusan, min, dan frekuensi. Keputusan menunjukkan bahawa pelajar UiTM Kedah menerima aplikasi *Mufradati* dengan baik dan positif. Ini menunjukkan bahawa elemen teknologi sangat relevan apabila diterapkan dalam pembelajaran perbendaharaan kata. Dengan adanya aplikasi ini, ia menjadi alternatif bagi pelajar untuk mempelajari kosa kata Arab secara bebas dan fleksibel.

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1. Pengenalan

Salah satu bahasa asing yang memerlukan pengetahuan tentang perbendaharaan kata adalah bahasa Arab yang menjadi cabaran kepada sesiapa yang ingin mempelajarinya. Kosa kata berfungsi sebagai asas pemahaman sesuatu bahasa. Supriadi dan Haslinda (2022) ada menyuarakan pandangan bahawa kosa kata ialah aspek penting dalam pembelajaran bahasa Arab kerana ia teras bahasa. Dalam satu pandangan lain dinyatakan bahawa pelajar sering menghadapi masalah menghafal perkataan, memahami makna dalam pelbagai konteks dan penggunaan perkataan dengan betul dalam ayat (Rifai, 2021).

Era revolusi perindustrian 4.0 yang dicirikan oleh globalisasi dan integrasi teknologi telah memberi implikasi kepada dunia pendidikan. Pendidikan 4.0 kini bertujuan mencipta peluang baru melalui kombinasi kreatif inovatif antara manusia dan teknologi serta persekitaran pembelajaran inovatif dan kreatif. Persekitaran pembelajaran ini bukan sahaja mendorong pelajar untuk memperoleh maklumat dan kemahiran yang diperlukan, tetapi ia juga memberi inspirasi kepada mereka untuk mencari sumber bagi mempelajari perkara-perkara tersebut. Pemilihan strategi berubah-ubah selari dengan peredaran masa (Caratozzolo et.al, 2023).

Perkembangan teknologi menyebabkan dunia moden kini berubah, memerlukan penyesuaian metodologi pembelajaran kepada generasi sekarang khususnya dalam pembelajaran kosa kata bahasa Arab. Penggunaan teknologi kini membantu mempercepatkan proses memperoleh kamus bahasa Arab. Perubahan ini juga menekankan signifikan pemilihan pendekatan yang selaras dengan keperluan generasi semasa dan kemajuan teknologi. Penggunaan teknologi bukan sahaja membantu pelajar mempelajari bahasa dengan lebih cepat, malah membekalkan mereka dengan kemahiran digital yang berguna yang diperlukan dalam dunia hari ini. Menurut Srivani et al. (2022), pelajar boleh memperoleh kemahiran kosa kata lebih cepat dan cekap dengan menggunakan aplikasi mudah alih, perisian pembelajaran interaktif dan platform e-learning yang memanfaatkan AI.

Pelbagai faktor seperti latar belakang pendidikan, strategi pengajaran yang digunakan dan kaedah pembelajaran yang sedia ada mempengaruhi kemampuan untuk menguasai kosa kata Arab. Pelajar yang mempunyai asas kukuh dalam bahasa-bahasa lain atau yang terdedah kepada bahasa Arab sejak kecil mungkin mempunyai penguasaan lebih positif. Pelajar yang kurang akan berasa terbeban dan menganggap bahasa Arab ialah bahasa yang sukar dipelajari. Antara faktor mempengaruhi ialah latar belakang pelajar dan kaedah pengajaran.

Strategi pengajaran dan latar belakang pelajar adalah dua elemen yang mempengaruhi. Latar belakang yang berbeza mungkin menyebabkan pelajar mempelajari bahasa Arab pada tahap kemahiran yang berbeza-beza. Kaedah pengajaran interaktif dan menggunakan teknologi moden seperti aplikasi pembelajaran bahasa boleh membantu meningkatkan minat dan kefahaman pelajar (Rifai, 2021).

2. Pernyataan Masalah

Perbincangan yang melibatkan aspek kosa kata Arab secara khususnya seringkali menjadi tajuk utama perbincangan secara hangat dalam kalangan pengkaji bahasa dan ilmuan akademik. Hal ini kerana pembelajaran yang melibatkan aspek kosa kata ialah satu proses pembelajaran dan penguasaan secara berterusan tanpa noktah. Perbincangan berkaitan kosa kata Arab khususnya dapat diamati dalam kajian-kajian yang telah direalisasikan oleh para pengkaji dan penyelidik.

Pengetahuan tentang perbendaharaan kata Arab dalam kalangan pelajar bahasa Arab di peringkat sarjana muda institusi awam telah dibincangkan oleh Samah et al. (2023) dalam satu kajian. Penemuan kajian menunjukkan bahawa perbendaharaan kata pelajar adalah berada pada tahap lemah. Beberapa kaedah dicadangkan untuk menangani isu ini, salah satunya adalah penggunaan pendekatan pembelajaran kosa kata. Strategi tersebut bertujuan untuk menilai prestasi pelajar dan tahap penguasaan perbendaharaan kata menggunakan kata-kata yang telah dipilih dan disaring.

Alwi dan Abdul Ghani (2023) dalam kajiannya membincangkan aspek penguasaan kosa kata penulisan bahasa Arab dalam kalangan pelajar Sekolah Menengah Agama di Terengganu. Penguasaan kosa kata Arab berkait rapat dengan kemahiran menulis. Antara cara yang diambil bagi meningkatkan kemahiran menulis ialah penguasaan kosa kata. Pelaksanaan aktiviti pengajaran pembelajaran bahasa Arab adalah berpusatkan pelajar. Kesenambungan daripada aktiviti yang tersebut memberikan pengalaman pelajar terhadap kemahiran menulis bahasa Arab dengan penguasaan kosa kata.

Norillah et.al (2023) membincangkan tentang beberapa faktor mempengaruhi penguasaan kosa kata pelajar. Penguasaan kosa kata yang baik memberikan implikasi terhadap kemahiran berkomunikasi dan usaha pelajar menguasai bahasa. Penguasaan kosa kata yang baik dalam kalangan para pelajar disebabkan beberapa faktor utama seperti psikologi, faktor pengajaran dan pembelajaran serta faktor kemahiran bahasa. Faktor-faktor lain juga turut dikenalpasti mempengaruhi kejayaan dalam pembelajaran bahasa iaitu faktor diri pelajar, faktor guru, persekitaran pembelajaran dan sosial.

Senario yang diutarakan oleh para pengkaji tersebut dapat dikaitkan dengan situasi yang wujud dari kalangan pelajar UiTM melibatkan aspek penguasaan kosa kata yang kurang baik. Aspek pembelajaran kosa kata bahasa Arab menjadi perkara dominan yang seharusnya diberikan perhatian untuk mengenal pasti dan menghuraikan isu pembelajaran kosa kata dari persepsi pelajar-pelajar. Perkara ini disokong dengan kenyataan Zulkepli et.al (2023) menyebut bahawa kelemahan kosa kata dapat dilihat melalui penghasilan skrip-skrip lakonan (*role-play*) yang dihasilkan pelajar kurang memuaskan. Ia gambaran kepada tahap penguasaan kosa kata para pelajar. Penguasaan pelajar terhadap kosa kata yang dipelajari menjadi kunci dan langkah pertama memahami bahasa tersebut serta menguasai tajuk pembelajaran dengan baik. Oleh itu, kajian ini bertujuan untuk membincangkan penerimaan para pelajar UiTM Kedah terhadap aplikasi *Mufradati* dari aspek pembelajaran kosa kata Arab.

3. Tinjauan Literatur

Hasil tinjauan lepas mendapati variasi kajian melibatkan aplikasi kosa kata dalam aspek pembelajaran bahasa Arab. Moh. Yusof Efendi dan Ahmad Suyuthi (2023) dalam kajiannya membincangkan penerapan kosa kata dalam pembelajaran bahasa Arab yang dikenali sebagai aplikasi *Solite Kids*. Ini adalah aplikasi untuk kanak-kanak yang dibangunkan dan termasuk lebih daripada 90 permainan pendidikan untuk mengajar kanak-kanak dari awal kanak-kanak, tadika dan sekolah rendah. Aplikasi ini mengandungi elemen yang menggabungkan visual dalam bentuk imej dan bunyi serta menggunakan latar belakang yang indah supaya anak-anak tidak bosan mendengar dan meniru perbendaharaan kata bahasa Arab. Aktiviti pembelajaran jenis ini disokong oleh teknologi sebagai alat pembelajaran berkonsepkan pembelajaran dengan telefon bimbit. Ini adalah satu langkah ke hadapan dalam era teknologi 4.0 hari ini yang lebih cenderung kepada penggunaan peranti. Dalam pengertian ini, aplikasi *Solite Kids* ini boleh digunakan sebagai pilihan pembelajaran untuk pelajar supaya proses pembelajaran dapat dinikmati dengan mudah dan hiburan.

Giatika dan Firman (2023) dalam kajiannya mengulas tentang aplikasi interaktif pembelajaran bahasa Arab yang digunakan dalam teknologi masa kini. Dengan kemajuan teknologi, Android ialah sistem pengendalian yang paling banyak digunakan untuk peranti mudah alih. Aplikasi pembelajaran berasaskan Android digunakan sebagai media pembelajaran dengan ciri yang mudah difahami oleh pengguna. Antara ciri-ciri yang dimaksudkan ialah kemudahan mengakses butang yang diingini. Kajian ini menghasilkan aplikasi bahasa Arab berasaskan Android dan mempunyai ciri visual yang tersendiri serta sarat dengan aktiviti dan visual. Aplikasi ini dibangunkan berdasarkan mata pelajaran yang akan diajar di sekolah. Aplikasi akan diuji terlebih dahulu, bertujuan untuk pakar atau guru yang mengajar bahasa Arab. Percubaan ini bertujuan untuk menjana pemikiran tentang pembelajaran bahasa Arab pada Android di sekolah. Hasilnya, ujian aplikasi ini menunjukkan keperluannya untuk menyokong pembelajaran.

Dalam kajian Putri (2023), terdapat perbincangan tentang penggunaan aplikasi *Kahoot* untuk meningkatkan kosa kata bahasa Arab di sebuah sekolah. Menurutnya, inovasi pada abad ke-21 dalam dunia pendidikan semakin berkembang untuk melakukan revolusi dalam pembelajaran dengan teknologi. Aplikasi *Kahoot* ialah salah satu platform kreatif dan inovatif yang boleh digunakan oleh guru dan pendidik. Justeru, pemerhatian dibuat terhadap sebuah sekolah iaitu SMA Islam Al-Falah Kota Jambi untuk menilai penerimaan pelajar terhadap aplikasi pembelajaran kosa kata bahasa Arab. Hasil kajian menunjukkan penggunaan aplikasi memberi kesan yang berkesan terhadap hafalan kosa kata bahasa Arab bagi pelajar sekolah. Penggunaan aplikasi *Kahoot* memberi impak positif kepada hasil pembelajaran bahasa Arab dan juga meningkatkan kebolehan aktif pelajar menghafal kosa kata bahasa Arab.

Zainuddin et al. al (2023) dalam satu kajiannya mengulas tentang kemudahan menggunakan aplikasi bernama *My Arabiy Game* untuk belajar bahasa Arab di sekolah. Aplikasi *My Arabiy Game* ini menawarkan banyak faedah kepada guru bahasa Arab kerana platform ini menyediakan kandungan yang tepat dan konsisten dengan program JAIS. Strukturnya jelas, menarik dan mudah difahami, membantu pelajar meningkatkan pemahaman mereka tentang pelajaran bilik darjah. Aplikasi ini juga mungkin berfungsi sebagai alat belajar sendiri yang membolehkan pelajar menggunakannya di luar bilik darjah tanpa bantuan guru dan kemudian menyatukan maklumat linguistik mereka. Guru seharusnya memberi tumpuan kepada strategi PdP berpusatkan pelajar untuk meningkatkan motivasi pelajar mempelajari bahasa Arab. Aplikasi *My Arabiy Game* boleh berguna dalam proses ini kerana ia menggalakkan interaksi antara guru dan pelajar serta menawarkan faedah yang berbeza kepada pengguna.

Kajian Nisa (2023) memfokuskan kepada kandungan pembelajaran kemahiran mendengar dalam aplikasi *Fun Easy Learn* dalam bahasa Arab berdasarkan piawaian ACTFL. Aplikasi ini bertujuan untuk membantu pelajar menguasai kemahiran mendengar mereka kerana orang ramai secara semula jadi memahami bahasa orang lain melalui kemahiran mendengar. Aplikasi *Fun Easy Learn* ini sesuai untuk pemula pertengahan dan lanjutan mengikut piawaian ACTFL dan menyediakan bahan yang disesuaikan dengan situasi sosial pengguna. Kandungan direka untuk membantu pelajar menerima dan memahami apa yang mereka dengar.

Abdullah et.al (2023) menjalankan tinjauan dalam kalangan pelajar berkaitan keberkesanan penggunaan aplikasi *Kahoot* dalam pengajaran dan pembelajaran. Aplikasi *Kahoot* ialah alat bantuan pendidikan popular yang menarik minat pelajar untuk menggunakannya. Ia satu bentuk aplikasi permainan yang dibentuk dan para guru atau pensyarah menyediakan soalan dalam portal tersebut. Hasil tinjauan dalam kalangan pelajar tentang penggunaan aplikasi bagi kod *al-adab al-arabi al-hadith* dan sejarah Islam dan tamadun menunjukkan kesan positif terhadap pembelajaran. Ini membantu untuk memahami dengan jelas pengajaran kursus. Dari perspektif kebolegunaan, aplikasi *Kahoot* meningkatkan penglibatan guru, mengurangkan kebosanan serta meningkatkan kelajuan pemikiran dan penumpuan. Ia juga turut membantu mengenalpasti kesilapan, mengurangkan tekanan tindak balas dan membantu dalam ingatan kandungan kuliah yang lebih mudah berbanding kaedah tradisional.

Dewi et.al (2023) membincangkan penggunaan aplikasi Tiktok dalam pengajaran bahasa Arab yang merangkumi aspek fonetik. Pembelajaran bahasa Arab diamalkan secara meluas dan dikongsi di rangkaian sosial terutamanya di TikTok. Platform ini membolehkan pengguna mencipta dan berkongsi video, menjadikannya medium hiburan yang popular. Kesilapan fonetik semasa mempelajari bahasa Arab di TikTok adalah minimum, memudahkan pelajar dan orang awam memahami pertuturan tersebut. Walau bagaimanapun, sesetengah akaun atau pencipta mungkin tidak menumpukan pada penyediaan bahan yang tidak diminati pelajar untuk mempelajari bahasa Arab. Kandungan yang memfokuskan kepada kemahiran bahasa Arab boleh memudahkan pelajar belajar terutamanya apabila mereka menghadapi kesukaran. Kandungan ini boleh menjadi pilihan bagi mereka yang menghadapi masalah bahasa Arab.

Rosalinda dan Muhammad (2023) mengulas tentang pembelajaran bahasa Arab melalui saluran media, termasuk aplikasi Canva. Inovasi dalam dunia pembelajaran di era globalisasi sangat diperlukan terutama melibatkan media pembelajaran. Media pembelajaran berfungsi sebagai alat pengajaran dan pembelajaran yang digunakan oleh pendidik. Ia juga dianggap sebagai pembantu atau fasilitator dalam proses pembelajaran berterusan atau berterusan. Hasil carian menunjukkan bahawa bahan pembelajaran bahasa Arab dengan aplikasi Canva sangat serasi. Ini kerana bahan pembelajaran yang disampaikan secara berurutan dan mudah difahami, dilengkapi dengan audio bagi memudahkan pelajar mengikuti pelajaran dan tidak bosan. Ini menggambarkan bahawa media tersebut sangat berkesan, inovatif dan berguna dari segi pembelajaran serta dapat meningkatkan motivasi untuk belajar.

Dalam kajian Panjaitan dan al-Rasyid (2023), dikemukakan pembangunan media pembelajaran komik Arab berasaskan Canva. Penyelidikan berbentuk *Research and Development (R&D)* ini dijalankan bersama pelajar yang menghasilkan produk dalam bentuk komik Arab (KOBAR) yang mengadaptasi aplikasi Canva. Hasil kajian terhadap perkembangan komik Arab berasaskan Canva merumuskan ia diiktiraf sebagai platform pembelajaran bahasa Arab. Satu ujian kesahan kebolehlaksanaan dilakukan oleh pakar media menunjukkan keputusan purata sebanyak 79% dan ujian pengesahan kebolehlaksanaan yang dilakukan oleh pakar bahan menunjukkan keputusan purata sebanyak 96%. Pembangunan media komik Arab (KOBAR) menunjukkan keputusan ujian guru Arab dengan purata skor 95% dan pelajar dengan purata skor 94%. Oleh

itu, komik Arab (KOBAR) berasaskan Canva boleh diaplikasikan kepada media pembelajaran bahasa Arab.

Nafiah (2023) membincangkan penggunaan kecerdasan buatan dalam pembelajaran bahasa Arab dalam talian dalam penghasilan tugas bahasa Arab melalui aplikasi *Liveworksheets*. Hasil kajian menyerlahkan potensi aplikasi *Liveworksheets* dalam pengajaran dan pembelajaran bahasa, menekankan kebolehcapaian praktikal, penilaian sendiri dan pelbagai bentuk soalan, sekaligus meningkatkan penguasaan pelajar terhadap topik linguistik. Menggunakan aplikasi *Liveworksheets*, pembelajaran bahasa Arab memberikan impaknya terhadap pengetahuan dan kemahiran pelajar, motivasi dan aktiviti interaktif mereka. Ia boleh digunakan berterusan untuk mempelajari bahasa Arab dalam talian sekaligus menggalakkan sikap positif terhadap pemerolehan bahasa kedua dan asing.

Dalam kajian Muhamad Khairul Anuar et al. (2023) membincangkan keperluan pembangunan aplikasi kosa kata *Mufradati* yang dibangunkan di UiTM. Dapatan hasil kajian menunjukkan satu penerimaan positif terhadap keperluan aplikasi tersebut. Keseluruhannya, penerimaan terhadap keperluan aplikasi *Mufradati* menggambarkan ia keperluan teknologi dalam pembelajaran kosa kata bahasa Arab. Sehubungan itu, ia menjadi penanda aras terhadap medium teknologi untuk meningkatkan motivasi dalam pembelajaran kosa kata bahasa Arab. Perkembangan teknologi seharusnya diberikan perhatian dalam pembangunan platform pembelajaran kondusif khususnya teknologi berasaskan telefon pintar yang dipelopori golongan muda. Aplikasi seperti *Mufradati* ini amat sesuai untuk dikembangkan dalam institusi pengajian khususnya di UiTM.

4. Metodologi

Pendekatan yang diadaptasi dalam kajian ini ialah pendekatan kualitatif berbentuk kajian kes. Ia digunakan atas dasar faktor tujuan kajian dan sasaran kumpulan yang ingin dikaji. Segala data kajian yang diperolehi dalam kajian ini hasil daripada soal selidik yang diadaptasi daripada soal selidik Nurahimah dan Muhammad Nidzam (2016) dengan beberapa sedikit pengubahsuaian. Soal selidik ini menggunakan skala Likert 5 iaitu 1 = sangat tidak setuju, 2 = tidak setuju, 3 = Neutral, 4 = setuju dan 5 = sangat setuju. Data terkumpul dibincangkan secara deskriptif. Item dalam soal selidik mengandungi lima (5) kategori iaitu:

Bahagian A: Demografi

Bahagian B: Penggunaan peranti telefon

Bahagian C: Capaian internet

Bahagian D: Penggunaan aplikasi *mufradati*

Bahagian E: Penerimaan aplikasi *mufradati* dalam pembelajaran

4.1 Lokasi kajian

Lokasi kajian bertempat di Universiti Teknologi Mara (UiTM) kampus Kedah. UiTM Kedah menjadi Lokasi pilihan utama kerana pada setiap semester ia menawarkan kod kursus bahasa Arab kepada para pelajar.

4.2 Populasi dan Persampelan

Populasi kajian terdiri daripada 260 orang mahasiswa UiTM Kedah dari semua semester yang mengambil subjek bahasa Arab. Saiz sampel pula terdiri daripada 155 orang mahasiswa program ijazah sarjana muda yang mengambil kursus bahasa Arab dipilih secara rawak mudah. Saiz sampel ini ditentukan menggunakan parameter yang digariskan oleh Krejcie & Morgan. (1970).

4.3 Analisis Data

Kajian yang dilakukan ini melibatkan responden dalam kalangan pelajar universiti tersebut. Data terkumpul dianalisis dan kemudian dibincangkan secara deskriptif melibatkan peratusan, min dan kekerapan. Dapatan yang diperoleh dihuraikan berpandukan interpretasi skor min yang diadaptasi daripada Nunnally dan Bernstein (1994).

Jadual 1
Interpretasi skor min

Skor Min	Interpretasi
1.00 – 2.00	Rendah
2.01 – 3.00	Sederhana rendah
3.01 – 4.00	Sederhana tinggi
4.01 – 5.00	Tinggi

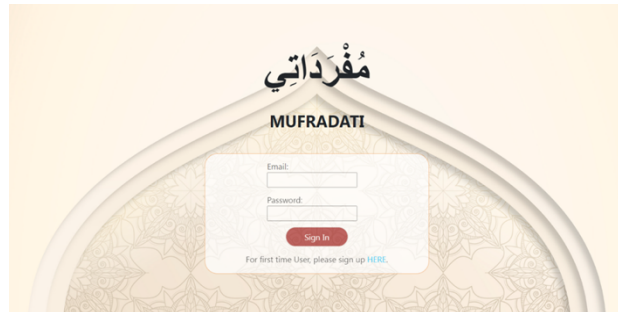
Source: Nunnally dan Bernstein (1994)

5. Aplikasi Mufradati

Aplikasi *Mufradati* ialah satu aplikasi kosa kata Arab yang dibangunkan menjadi inisiatif dan alternatif memenuhi keperluan pelajar UiTM Kedah dalam pembelajaran kosa kata Arab. Ini terdiri daripada beberapa komponen seperti berikut:

5.1 Paparan Muka Hadapan Aplikasi

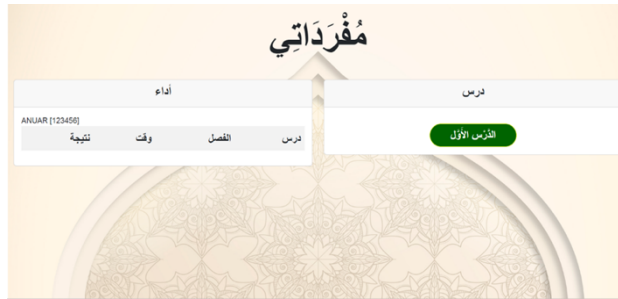
Aplikasi ini dimulakan dengan paparan muka hadapan. Paparan ini memerlukan pengguna mendaftar terlebih dahulu email dan kata laluan. Seterusnya, ia akan membawa pengguna untuk meneroka setiap kandungan yang ada.



Rajah 1. Paparan Muka Hadapan

5.2 Pembinaan Kandungan Aplikasi

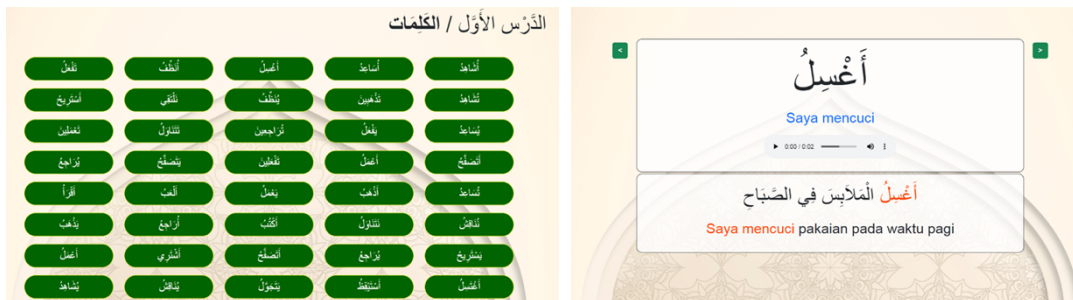
Paparan menu utama dalam rajah 2 mengandungi modul dimuatkan dalam aplikasi. Skrin menu memaparkan tajuk pelajaran sebagaimana disusun dalam silibus. Pengguna boleh memilih dan menekan butang tajuk pelajaran kandungan modul untuk menerokai kandungan pelajaran.



Rajah 2. Kandungan Modul

5.3 Paparan Skrin Menu Kosa Kata Dan Audio Perkataan

Rajah 3 menunjukkan paparan kosa kata dalam aplikasi. Pengguna mempunyai kebebasan memilih butang perkataan yang diinginkan dan setiap kosa kata memaparkan penggunaannya dalam ayat diikuti paparan audio yang boleh dimainkan oleh pengguna. Pengguna boleh mendengar audio sebutan perkataan tersebut sambil mempraktikkannya secara sendiri.



Rajah 3. Menu Kosa Kata Dan Audio Perkataan

5.4 Paparan Skrin Aktiviti

Skrin memaparkan aktiviti sekiranya pengguna menekan butang aktiviti. Dalam paparan ini, dua aktiviti tertera sebagai latihan kosa kata untuk pengguna. Aktiviti satu berbentuk aktiviti kuiz aneka pilihan manakala aktiviti dua pula berbentuk pilih jawapan yang betul



Rajah 4. Paparan Aktiviti

6. Dapatan dan Perbincangan

Dapatan kajian dibentangkan melalui jadual berikut berdasarkan item-item soal selidik yang telah ditetapkan.

6.1 Demografi

Jadual 2
Jantina

Jantina	Bilangan	Peratus (%)
Lelaki	70	45.2
Perempuan	85	54.8

Jadual 2 menunjukkan jumlah responden yang terlibat adalah sebanyak 155 orang yang terdiri daripada 85 perempuan (54.8%) dan 70 lelaki (45.2%). Jumlah responden perempuan dalam kajian ini lebih ramai berbanding responden lelaki.

Jadual 3
Penggunaan Peranti Telefon

Item	Bilangan	Peratus (%)
Android OS	90	58.1
iPhone Os/iOS (Apple)	65	41.9

Statistik dalam Jadual 3 mendapati majoriti responden (n=90, 58.1%) menggunakan peranti Android OS manakala 65 responden (41.9%) menggunakan peranti iPhone OS/iOS (Apple). Dapat dirumuskan bahawa peranti dengan Android OS menjadi pilihan utama pelajar UiTM.

Jadual 4
Capaian Internet

Item	Bilangan	Peratus (%)
Internet (WiFi/Wireless)	105	67.7
Data internet telefon pintar	85	54.8
Internet jalur lebar (broadband)	45	29.0

Jadual 4 menunjukkan jumlah penggunaan internet dalam kalangan responden. Penggunaan (WiFi/Wireless) menjadi pilihan utama dengan jumlah 105 responden (67.7%) diikuti penggunaan data internet telefon pintar sebanyak 85 responden (54.8%). Penggunaan internet jalur lebar (broadband) adalah pilihan yang sedikit dalam lingkungan 29% (45 responden).

6.2 Penggunaan Aplikasi Mufradati

Jadual 5

Penggunaan Aplikasi Mufradati

Item		Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju	Min
1	Susunan isi kandungan adalah teratur.	3 (1.9%)	10 (6.5%)	25 (16.1%)	85 (54.8%)	32 (20.6%)	3.86
2	Ayat yang digunakan mudah difahami.	2 (1.3%)	8 (5.2%)	20 (12.9%)	90 (58.1%)	35 (22.6%)	3.96
3	Grafik digunakan adalah menarik.	5 (3.2%)	12 (7.7%)	30 (19.4%)	75 (48.4%)	33 (21.3%)	3.77
4	Warna digunakan adalah bersesuaian.	4 (2.6%)	10 (6.5%)	22 (14.2%)	80 (51.6%)	39 (25.2%)	3.90
5	Susunan butang yang digunakan sesuai.	3 (1.9%)	9 (5.8%)	28 (18.1%)	85 (54.8%)	30 (19.4%)	3.83
6	Font yang digunakan menarik.	4 (2.6%)	12 (7.7%)	26 (16.8%)	75 (48.4%)	38 (24.5%)	3.84
7	Arahan dalam aplikasi ini mudah diikuti.	3 (1.9%)	8 (5.2%)	23 (14.8%)	85 (54.8%)	36 (23.2%)	3.92
8	Bahasa dalam aplikasi ini mudah difahami.	2 (1.3%)	7 (4.5%)	20 (12.9%)	90 (58.1%)	36 (23.2%)	3.97
9	Aplikasi ini bersifat mesra pengguna.	4 (2.6%)	8 (5.2%)	25 (16.1%)	85 (54.8%)	33 (21.3%)	3.87
10	Aplikasi ini mudah dikendalikan.	3 (1.9%)	10 (6.5%)	23 (14.8%)	85 (54.8%)	34 (21.9%)	3.88

Jadual 5 menunjukkan respon yang diberikan oleh para responden terhadap setiap item dalam borang soal selidik. Item 1 mendapati 75.4% responden bersetuju dan sangat bersetuju bahawa konten dan susunan isi kandungan dalam aplikasi *Mufradati* adalah teratur dengan min 3.86. Ini penting kerana struktur yang teratur membantu pelajar menavigasi dan memahami maklumat dengan lebih baik. Struktur susunan sesuatu aplikasi merupakan cerminan kepada daya upaya untuk menarik minat pelajar bagi lebih mengakses.

Item 2 merekodkan 81.3% responden bersetuju dan sangat bersetuju bahawa ayat dan bahasa yang digunakan dalam aplikasi ini sangat mudah difahami dengan skor min 3.96. Penggunaan bahasa yang jelas dan mudah menjadi salah satu kriteria penting dalam aplikasi pembelajaran kerana ia mempengaruhi tahap kefahaman pelajar.

Item 3 dan 4 mencatatkan skor min 3.77 dan 3.90 berkaitan grafik dan warna dalam aplikasi ini. Sebanyak 69.7% responden bersetuju dan sangat bersetuju bahawa penggunaan grafik dalam aplikasi ini adalah menarik dan 76.8% setuju bahawa warna yang digunakan sesuai. Pemilihan

grafik dan warna yang menarik adalah elemen yang tidak boleh diabaikan bagi memastikan pelajar tetap bermotivasi dan tertarik untuk menggunakan aplikasi.

Item 5 mencatatkan skor min 3.83 membabitkan aspek keserasian susunan butang. Sebanyak 74.2% responden bersetuju dan sangat bersetuju dengan keserasian susunan butang yang sesuai dalam aplikasi ini. Item 6 memaparkan min 3.84 terhadap aspek tulisan atau *font* yang digunakan. Sebanyak 48.4% dan 24.5% responden setuju dan sangat setuju dengan kesesuaian tulisan atau *font* yang diadaptasikan dalam aplikasi ini. Item 7 menunjukkan skor min 3.92 terhadap aspek arahan yang direka dalam aplikasi *Mufradati*. Sebanyak 78.0% responden bersetuju dan sangat bersetuju bahawa arahan yang digunakan dalam aplikasi ini jelas dan mudah diikuti. Panduan yang mudah difahami dan jelas dalam aplikasi pembelajaran digital dapat meningkatkan kecekapan penggunaan aplikasi tersebut.

Item 8 merujuk kepada aspek penggunaan bahasa dalam aplikasi dengan skor min 3.97. Sebanyak 81.3% responden bersetuju dan sangat bersetuju bahawa penggunaan bahasa dalam aplikasi ini mudah difahami. Penggunaan bahasa yang bersesuaian dengan tahap pelajar adalah faktor utama dalam penyampaian maklumat secara efektif. Item 9 dengan min 3.87 adalah interpretasi kepada sifat aplikasi yang mesra pengguna. Sebanyak 76.1% responden bersetuju dan sangat bersetuju bahawa aplikasi ini bersifat mesra pengguna. Mesra pengguna merujuk kepada kebolegunaan aplikasi yang responsif apabila digunakan. Item 10 mencatatkan skor min 3.88 dan merujuk kepada pengendalian aplikasi *Mufradati*. Dapatan menunjukkan 76.7% responden bersetuju dan sangat bersetuju bahawa aplikasi ini mudah dikendalikan sama ada menerusi telefon pintar, komputer, atau komputer riba. Ini menjadi satu kriteria penting dalam reka bentuk aplikasi.

Dapatan kajian ini menghuraikan penilaian dan penerimaan positif pelajar terhadap keupayaan aplikasi *Mufradati* seiring dengan ciri-cirinya yang mengadaptasikan elemen-elemen teknologi. Hal ini diperkuatkan lagi dengan pandangan Dagdele (2023) bahawa penggunaan teknologi mudah alih mampu meningkatkan pembelajaran kosa kata. Ini menunjukkan signifikan teknologi terhadap pembelajaran kosa kata melalui penggunaan aplikasi mudah alih. Pandangan tersebut turut diperkukuhkan oleh Abu al-majd dan Belton (2024) dimana pembelajaran berkonsepkan teknologi sememangnya menunjukkan potensi besar; namun, pembelajaran kosa kata yang tidak menggunakan teknologi turut memberikan pembelajaran yang baik. Tuntasnya, pendekatan teknologi dan tanpa teknologi sesuai digabungkan bagi mencapai hasil pembelajaran kosa kata yang optimum.

Jadual 6

Interpretasi Skor Min Penggunaan Aplikasi Mufradati

Item		Min	Interpretasi
1	Susunan isi kandungan adalah teratur.	3.86	Sederhana tinggi
2	Ayat yang digunakan mudah difahami.	3.96	Sederhana tinggi
3	Grafik digunakan menarik.	3.77	Sederhana tinggi
4	Warna digunakan bersesuaian.	3.90	Sederhana tinggi
5	Susunan butang yang digunakan sesuai.	3.83	Sederhana tinggi
6	Font yang digunakan menarik.	3.84	Sederhana tinggi
7	Arahan dalam aplikasi mudah diikuti.	3.92	Sederhana tinggi
8	Bahasa dalam aplikasi mudah difahami.	3.97	Sederhana tinggi
9	Aplikasi ini bersifat mesra pengguna.	3.87	Sederhana tinggi
10	Aplikasi ini mudah dikendalikan.	3.88	Sederhana tinggi

6.3 Penerimaan Pelajar UiTM Terhadap Aplikasi Mufradati Dalam Pembelajaran

Jadual 7

Penerimaan Pelajar Terhadap Aplikasi Mufradati

Item	Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju	Min
1 Saya setuju aplikasi <i>Mufradati</i> dijadikan medium dalam pembelajaran.	5 (3.2%)	10 (6.5%)	30 (19.4%)	75 (48.4%)	35 (22.6%)	3.80
2 Saya yakin aplikasi <i>Mufradati</i> membantu untuk mengulangkaji pembelajaran.	7 (4.5%)	15 (9.7%)	25 (16.1%)	70 (45.2%)	38 (24.5%)	4.07
3 Saya setuju aplikasi ini mudah digunakan.	3 (1.9%)	8 (5.2%)	20 (12.9%)	85 (54.8%)	39 (25.2%)	3.96
4 Saya setuju aplikasi ini dijadikan platform interaktif dalam pembelajaran.	6 (3.9%)	12 (7.7%)	28 (18.1%)	78 (50.3%)	31 (20.0%)	3.74
5 Saya setuju aplikasi <i>Mufradati</i> membantu dalam meningkatkan pembelajaran kosa kata Arab.	4 (2.6%)	8 (5.2%)	25 (16.1%)	80 (51.6%)	38 (24.5%)	3.83

Jadual 7 menunjukkan tahap penerimaan pelajar terhadap penggunaan aplikasi *Mufradati* dalam pembelajaran. Item 1 merekodkan min 3.80 dimana 48.4% dan 22.6% responden bersetuju dan sangat bersetuju tentang penggunaan aplikasi *Mufradati* sebagai medium dalam pembelajaran. Ini menunjukkan penerimaan baik pelajar terhadap penerapan aplikasi ini dalam pembelajaran kosa kata Bahasa Arab. Perkara ini selaras dengan pandangan yang diutarakan oleh Saif et al. (2020) dan AlMarwani (2020) dimana aplikasi mudah alih semakin diterima sebagai alat pembelajaran dalam kalangan pelajar kerana ianya mudah diakses dan menawarkan pelbagai kemudahan.

Item 2 mencatatkan min tertinggi sebanyak 4.07 dengan 45.2% dan 24.5% responden setuju dan sangat bersetuju bahawa aplikasi *Mufradati* membantu mereka mengulang kaji pembelajaran. Walaupun terdapat sebahagian kecil responden yang tidak bersetuju (14.2%), majoriti responden yakin bahawa aplikasi ini memberi manfaat. Ini sejajar dengan kenyataan Bazhenova et al. (2022) bahawa aplikasi pembelajaran mudah alih dapat meningkatkan ingatan dan pengulangan semula pelajar melalui pendekatan interaktif dan personifikasi pembelajaran.

Item 3 mencatatkan skor min 3.96 dan menggambarkan persetujuan dalam kalangan responden dimana 54.8% dan 25.2% bersetuju dan sangat bersetuju bahawa aplikasi ini mudah digunakan. Ini membuktikan bahawa sesuatu aplikasi seharusnya bersifat mudah digunakan dan fleksibel. Menurut Nugraheni et al. (2024), penekanan terhadap kepentingan reka bentuk mesra pengguna untuk aplikasi pembelajaran dapat meningkatkan penglibatan pelajar dan mengurangkan keciciran dalam penggunaan aplikasi.

Item 4 merekodkan min 3.74 dimana 50.3% responden bersetuju dan 20.0% responden sangat bersetuju bahawa aplikasi *Mufradati* boleh dijadikan platform interaktif dalam pembelajaran. Hanya 11.6% responden tidak bersetuju dan ini menunjukkan kebanyakan pelajar menghargai elemen interaktif dalam aplikasi ini. Dapat dirumuskan bahawa sesuatu aplikasi boleh

dimanfaatkan dan diaplikasikan sebagai platform pembelajaran berguna masa kini kerana ia berkaitan dengan elemen motivasi dan minat dalam pembelajaran. al-Zarfi et al. (2024) dan Kherazi (2024) berpendapat bahawa elemen interaktif dalam aplikasi pembelajaran amat berkesan untuk meningkatkan motivasi pelajar dan mendorong pembelajaran sendiri, sekali gus memperbaiki prestasi akademik.

Item 5 dengan min 3.83 menunjukkan 51.6% dan 24.5% responden setuju dan sangat bersetuju bahawa aplikasi *Mufradati* berupaya meningkatkan pembelajaran kosa kata Bahasa Arab. Ini menunjukkan bahawa majoriti responden (76.1%) menunjukkan kesepakatan positif terhadap keberkesanan aplikasi ini dalam memperbaiki penguasaan kosa kata Arab mereka. Sebahagian kecil responden (7.8%) tidak bersetuju dengan kenyataan ini manakala selebihnya adalah neutral (16.1%). Ini mencerminkan bahawa terdapat faktor-faktor lain yang mempengaruhi pengalaman pengguna tertentu seperti latar belakang akademik, tahap penguasaan bahasa, atau kaedah penggunaan aplikasi tersebut.

Dapatan dari soal selidik ini secara keseluruhannya menunjukkan penerimaan positif dan sambutan yang memberangsangkan terhadap aplikasi *Mufradati* dalam kalangan majoriti pelajar di UiTM Kedah. Kebanyakan pelajar bersetuju bahawa aplikasi ini mudah digunakan, membantu dalam mengulang kaji pembelajaran, sesuai dijadikan sebagai platform interaktif dalam pembelajaran, dan membantu meningkatkan pembelajaran kosa kata Bahasa Arab. Sokongan dan dorongan positif ini menyerlahkan potensi besar aplikasi *Mufradati* untuk terus digunakan sebagai alat bantu pembelajaran Bahasa Arab yang efektif.

Jadual 8

Penerimaan Pelajar UiTM Terhadap Aplikasi Mufradati Dalam Pembelajaran

Item	Min	Interpretasi
1 Saya setuju aplikasi <i>Mufradati</i> dijadikan medium dalam pembelajaran.	3.80	Sederhana tinggi
2 Saya yakin aplikasi <i>Mufradati</i> membantu untuk mengulangkaji pembelajaran.	4.07	Tinggi
3 Saya setuju aplikasi ini mudah digunakan.	3.96	Sederhana tinggi
4 Saya setuju aplikasi ini dijadikan platform interaktif dalam pembelajaran.	3.74	Sederhana tinggi
5 Saya setuju aplikasi <i>Mufradati</i> membantu dalam meningkatkan pembelajaran kosa kata Arab.	3.83	Sederhana tinggi

7. Kesimpulan

Hasil kajian mendapati penggunaan aplikasi *Mufradati* mendapat penerimaan baik dan positif dalam kalangan pelajar di UiTM Kedah. Ia boleh dijadikan sebagai platform sampingan dalam pengajaran dan pembelajaran Bahasa Arab dan berperanan sebagai alternatif yang membantu penyampaian ilmu dan pengetahuan dengan lebih menarik dan fleksibel. Ini kerana proses pembelajaran sentiasa berubah mengikut peredaran dan perkembangan semasa dan perlu disesuaikan dengan kesesuaian zaman.

Pembelajaran kosa kata Arab merupakan satu bentuk pembelajaran yang boleh dilaksanakan melalui variasi pendekatan yang interaktif dan efektif. Namun, penguasaan kosa kata oleh para pelajar sememangnya tidak sunyi dari pelbagai permasalahan. Justeru, teknologi masa kini wajar dimanfaatkan bersama dalam proses penyampaian ilmu yang bersifat pembelajaran

sepanjang hayat. Aplikasi *Mufradati* ini diharap dapat memberi sumbangan kepada seluruh pelajar UiTM dalam mempelajari kosa kata Bahasa Arab.

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Authors Contributions

Penulis pertama menjalankan kerja lapangan, mengkonseptualisasikan kajian, merangka metodologi dalam reka bentuk kajian dan penyemakan artikel penuh. Penulis kedua, ketiga dan keempat menyediakan tinjauan literatur komprehensif. Penulis kelima menjalankan analisis statistik dan tafsiran keputusan, perbincangan analisis statistik data.

Conflict of Interest

Tiada konflik kepentingan yang dikaitkan dengan penerbitan ini.

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EXAMINING THE IMPACT OF ENVIRONMENTAL EDUCATION, RELIGIOUSITY AND POLICY, RULES AND REGULATION ON BEHAVIOURAL CHANGE TOWARDS GREEN LIFESTYLE

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ABSTRACT

Environmental sustainability is an urgent global concern, necessitating significant behavioral changes at individual and societal levels which calls for conservation. These changes include adopting eco-friendly practices such as consuming green products, supporting the circular economy, reducing waste, and advocating clean energy. Achieving such transformations requires a multi-faceted approach that integrates knowledge dissemination, religious teachings, and policy interventions. This study explores the combined influence of these factors—mediated by subjective norms—on fostering behavioral changes toward environmental sustainability among university students. Based on the Theory of Planned Behavior and Norm Activation Theory, the study examines how knowledge equips individuals with critical awareness, how Islamic teachings promote values of stewardship and moderation, and how policy frameworks regulate and incentivize sustainable practices. It emphasizes the underexplored role of Islamic principles, which align spiritual values with ecological stewardship, advocating conservation as a sacred trust. Policies aimed at reducing pollution and promoting clean energy are evaluated for their effectiveness in driving behavioral change when aligned with cultural and spiritual dimensions. The study uses PLS-SEM as the tool for analysis. Results conform to the hypotheses where knowledge, religiosity, and policy, rules and regulation with the mediating effect of subjective norms have significant impact on behavioural changes toward environmental sustainability. The study offers theoretical, empirical, and practical contributions by developing an integrative conceptual model, shedding light on youth engagement in

sustainability, and informing educational, religious, and policy initiatives. This approach underscores the importance of value-driven, culturally relevant strategies for achieving environmental sustainability.

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1. Introduction

Environmental sustainability has emerged as a critical concern in light of escalating challenges such as climate change, biodiversity loss, and resource depletion. Addressing these issues requires profound behavioral changes at both individual and societal levels. These changes encompass adopting environmentally friendly practices, such as consuming green products, purchasing from sustainable producers, practicing waste reduction through reuse and recycling, supporting the circular economy, and advocating for clean energy. Achieving this transformation necessitates a multi-faceted approach incorporating knowledge dissemination, religious teachings, and policy interventions. This study explores how knowledge, religiosity, and policies—mediated by subjective norms—can collectively influence behavioral changes toward environmental sustainability.

Despite growing awareness of environmental issues, behavioral inertia persists, impeding the adoption of sustainable lifestyles. Existing approaches to environmental sustainability often fail to address the interplay of cultural, spiritual, and regulatory influences that shape individual and collective behaviors. Religious teachings, particularly within Islam, offer profound ethical frameworks emphasizing stewardship, moderation, and conservation. However, these teachings remain underutilized in fostering pro-environmental behaviors. Furthermore, while environmental policies and regulations aim to mitigate pollution and promote clean energy, their effectiveness is contingent upon public compliance and attitudinal alignment. Knowledge dissemination, though a critical enabler, often lacks the contextual integration needed to resonate with diverse populations, particularly university students, who represent future leaders and change-makers.

Environmental education is pivotal in equipping individuals with the knowledge and skills required to address environmental challenges. It fosters awareness, critical thinking, and collective action aimed at conserving natural resources and mitigating environmental degradation. By promoting informed decision-making, environmental education serves as a foundation for sustainable behavior. However, knowledge alone is insufficient; it must be complemented by cultural and spiritual dimensions to inspire deeper, value-driven commitments to environmental stewardship.

Islam, as a comprehensive way of life, provides a robust ethical framework for environmental sustainability. Hundreds of Qur'anic verses emphasize humanity's responsibility as stewards of the Earth, advocating for the preservation of God's creation. Core Islamic principles such as *Tawheed* (unity of creation), moderation (*wasatiyyah*), and the prohibition of wastefulness (*isrāf*) align closely with sustainability goals. For instance, Qur'an 7:31 warns against excessive consumption, and Qur'an 17:37 cautions against arrogance and destruction of the Earth. These teachings not only promote ecological balance but also imbue environmental actions with spiritual significance. The Islamic Climate Change Symposium's 2015 declaration underscores the role of Islam in addressing global environmental challenges. Islamic organizations and scholars increasingly highlight the compatibility of Islamic teachings with sustainability, advocating for conservation practices that resonate with religious communities. Nevertheless, the potential of Islamic principles to drive behavioral change remains underexplored, particularly in the context

of youth and university students. Religion profoundly shapes values related to nature through personal, social, and more-than-human processes. Personal transformation often arises from religious practices such as prayer and meditation, fostering gratitude, humility, and relational values toward nature. Socially, religious teachings are transmitted through family traditions, educational institutions, and community activities, embedding pro-environmental norms within cultural contexts. Religious rituals frequently incorporate natural elements, enhancing ecological awareness and inspiring conservation efforts. More-than-human processes emphasize divine and supernatural connections, aligning with Indigenous and animistic traditions that integrate nature into spiritual frameworks. This perspective broadens the scope of environmental ethics, viewing nature not merely as a resource but as a sacred trust. Together, these dimensions illustrate religion's multifaceted role in shaping environmental values and actions.

Policy interventions are critical for mitigating environmental degradation by regulating behaviors and promoting sustainable practices. Governments employ a combination of punitive and incentivizing measures, such as taxing polluters, subsidizing clean energy, and enforcing environmental standards. These mechanisms aim to internalize environmental costs and encourage the adoption of green technologies. For instance, Neves et al. found that market-based regulations effectively reduce CO₂ emissions over the long term.

However, the success of environmental policies depends on societal compliance and attitudinal shifts. Policies alone cannot drive change unless they resonate with individual values and subjective norms. Integrating policy frameworks with cultural and spiritual dimensions could enhance their acceptability and effectiveness. As such, this study integrates the Theory of Planned Behavior (TPB) and Norm Activation Theory (NAT) to examine the factors influencing behavioral changes toward environmental sustainability. TPB posits that behavioral intentions are shaped by attitudes, subjective norms, and perceived behavioral control. NAT complements this by emphasizing the activation of personal norms through awareness of consequences and ascription of responsibility.

The conceptual model developed in this study incorporates knowledge, religiosity, and policy frameworks as antecedents of subjective norms, which in turn mediate their influence on pro-environmental behaviors. This integrative approach allows for a holistic understanding of the factors driving sustainable behaviors among university students.

The primary objective of this study is to examine how knowledge, religiosity, and policy interventions—mediated by subjective norms—contribute to behavioral changes toward environmental sustainability. This study makes several key contributions: Theoretical Contribution - By integrating TPB and NAT, the study provides a comprehensive framework for understanding the interplay of knowledge, religiosity, and policies in shaping pro-environmental behaviors. Empirical Contribution - The focus on university students offers insights into the factors influencing behavioral changes in a critical demographic that will shape future sustainability initiatives. Practical Contribution - The findings can inform the design of educational programs, religious outreach initiatives, and policy interventions aimed at fostering environmental sustainability. Cultural Relevance - By emphasizing Islamic teachings, the study highlights the potential of culturally and spiritually aligned approaches to drive behavioral change in predominantly Muslim contexts.

Addressing environmental challenges requires a multi-dimensional approach that integrates knowledge, spiritual values, and policy interventions. This study bridges these domains by examining how environmental education, Islamic teachings, and regulatory frameworks influence pro-environmental behaviors. By focusing on university students, the study contributes to

the growing body of literature on youth engagement in sustainability and offers practical recommendations for fostering behavioral change. The proposed conceptual model provides a robust foundation for future research and policy development aimed at achieving environmental sustainability through value-driven actions

The following sections are organized as follows. The next section narrates the theory, conceptual framework along with the relevant review of literature. Section 3 explains the methodological approach followed by presentation of the results. The penultimate section discusses the results and limitation of the study, and the final section concludes.

2. Literature Review, Theory and Conceptual Framework

The Norm Activation Theory (NAT), introduced by Schwartz in 1977, provides a theoretical framework for understanding altruistic and environmentally conscious behaviors that arise from internalized norms. Schwartz posited that NAT establishes a relationship between personal norms (PN), activators, and behaviors (Schwartz, 1977; Schwartz and Howard, 1984; Harland et al., 2007). According to Schwartz, personal norms require activators, such as specific triggers or situational cues, to motivate individuals toward pro-social behaviors (Schwartz, 1977).

To enhance the predictive capabilities of the NAT model, researchers have incorporated additional variables, such as social norms (SN), which represent the influence of societal expectations, alongside awareness of consequences (AC), ascription of responsibility (AR), and efficacy (Bamberg et al., 2007; Onwezen et al., 2014; Han, 2014). These extensions have strengthened the utility of NAT in explaining and predicting environmentally friendly behaviors. Several empirical studies have validated the effectiveness of NAT in this context (Ebreo et al., 2003; Zhang et al., 2013; Van der Werff and Steg, 2015). Green Purchase Intention (Green PI) is one application of NAT, referring to the likelihood and motivation to purchase products with environmentally friendly features (Yusof et al., 2013). The connection between NAT and Green PI underscores the importance of internalized values in promoting sustainable consumer choices.

In the current study, we hypothesized that anticipated pride and guilt play a critical role in driving behaviors aligned with personal norms. Anticipated emotions, such as pride and guilt, act as self-regulatory mechanisms that mediate the relationship between personal norms and actual behavior. Our findings support this hypothesis, demonstrating that anticipated emotions effectively mediate the influence of personal norms on pro-environmental behaviors. Further analysis revealed that these relationships persisted even when the Theory of Planned Behavior (TPB) was integrated into the Norm Activation Model (NAM). In the combined NAM-TPB framework, anticipated emotions influenced behavior indirectly through behavioral intentions. This finding highlights the complex interplay between emotional, normative, and intentional factors in shaping environmentally responsible actions.

The implications of these findings suggest that fostering positive anticipated emotions, such as pride, while mitigating negative ones, like guilt, could strengthen the effectiveness of interventions designed to promote pro-environmental behaviors. By integrating both NAT and TPB perspectives, this study contributes to a more nuanced understanding of the psychological mechanisms underpinning sustainable behavior, offering valuable insights for policymakers and practitioners aiming to encourage environmentally conscious actions.

The Theory of Planned Behavior (TPB) by Ajzen (2011) is essentially an extension of the Theory of Reasoned Action, provides a comprehensive framework for understanding the factors influencing an individual's intention to engage in a specific behavior. This theory delineates three distinct categories of beliefs that collectively shape behavioral intentions and, ultimately, behavior itself.

Firstly, behavioral beliefs refer to an individual's perceptions of the likely outcomes or consequences of performing a behavior. These beliefs form the foundation of attitudes toward the behavior, which can be positive or negative depending on whether the expected outcomes are deemed favorable or unfavorable. For instance, if an individual believes that adopting environmentally friendly practices will lead to significant benefits, such as reduced pollution, they are more likely to develop a positive attitude toward these practices.

Secondly, normative beliefs pertain to the perceived social pressures or expectations from influential figures, peers, or societal norms regarding the behavior in question. These beliefs shape subjective norms, which reflect the degree to which individuals feel compelled to conform to others' expectations. For example, if a student perceives that their friends and mentors value environmental sustainability, they may feel motivated to align their behavior accordingly.

Lastly, control beliefs are concerned with an individual's perception of their ability or resources to execute the behavior successfully. These beliefs influence perceived behavioral control, which encompasses the ease or difficulty of performing the behavior. Factors such as access to resources, knowledge, and external barriers play a critical role in shaping this perception.

Together, these three belief systems – behavioral, normative, and control – form the theoretical underpinnings of the TPB, offering valuable insights into the cognitive processes that drive intentional behavior. By understanding these components, researchers and practitioners can better design interventions to foster positive behavioral changes in diverse contexts, including health promotion, environmental sustainability, and social responsibility. Based on the foregoing discussion, the following hypotheses were developed:

H1: Knowledge lead to behavioural changes towards environmental sustainability through the mediation effect of subjective norms.

H2: Religiosity lead to behavioural changes towards environmental sustainability through the mediation effect of subjective norms.

H3: Policy, rules and regulation lead to behavioural changes towards environmental sustainability through the mediation effect of subjective norms.

H4: Subjective norms leads to behavioural changes towards environmental sustainability since individuals tend to behave in a manner that is in line with social norms.

The conceptual framework is illustrated in Figure 1.

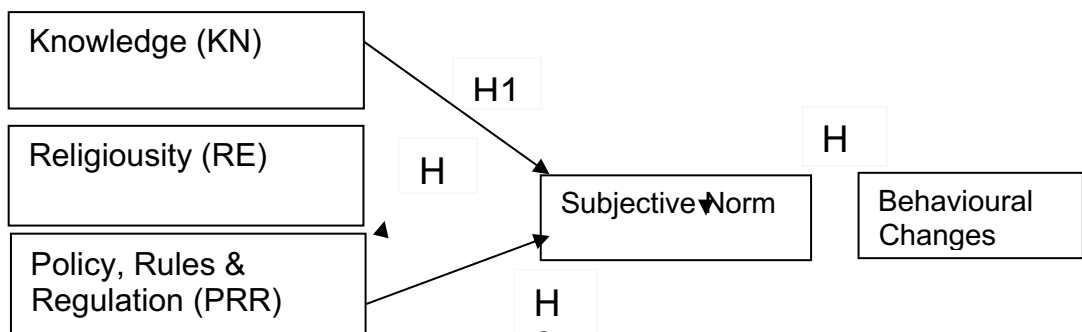


Figure 1. Conceptual Framework (xxx et al. 2021)

3. Methodology

This study employs Partial Least Squares Structural Equation Modelling (PLS-SEM) to investigate the complex interrelationships among knowledge, reasons for usage, attitude, willingness, and digital hesitancy. PLS-SEM is a robust multivariate analysis technique that offers several significant advantages, making it particularly suitable for this research. It is highly flexible in handling non-normal data distributions, which are common in social science research. Additionally, it is well-suited for small sample sizes and is particularly effective for exploratory studies, where the objective is to identify and test theoretical relationships.

Following the methodological guidelines proposed by Anderson and Gerbing (1988), this study adopts a two-step analytical approach using PLS-SEM. The first step involves evaluating the measurement model to ensure the reliability and validity of the constructs. This includes assessing the internal consistency, convergent validity, and discriminant validity of the measurement items. The second step focuses on analyzing the structural model, which tests the hypothesized relationships between latent variables and evaluates the model's predictive relevance and overall fit. This systematic approach ensures a rigorous examination of the theoretical framework and enhances the reliability of the findings.

3.1 Sample and procedure

This research adopts a quantitative methodology, utilizing a survey questionnaire as its primary tool for data collection. The design of the questionnaire was carefully constructed to align with the research objectives and to be comprehensible to students, who form the study's primary respondents. The diverse demographic and educational backgrounds of the students, as well as their varying levels of understanding regarding environmental sustainability, necessitated a thorough review process to ensure clarity and relevance. To this end, the questionnaire was rigorously verified by three internal experts. These experts, all seasoned economics lecturers with over a decade of teaching experience, provided valuable insights to ensure that the questions accurately captured the essence of the research objectives while being accessible to respondents.

Recognizing the potential influence of diversity on the respondents' engagement with environmental sustainability issues, particular emphasis was placed on refining the questionnaire for clarity and contextual appropriateness. This iterative refinement process aimed to minimize ambiguities and ensure that the questions were both inclusive and representative of the target population's perspectives. To further enhance the reliability and validity of the survey instruments, a pilot survey was conducted. The pilot study involved the distribution of 30 questionnaires to a sample group of students. Additionally, follow-up interviews were conducted with 10 respondents from this pilot group to gather detailed feedback on their experience with the questionnaire. These interviews were instrumental in identifying and addressing any issues related to the wording, structure, and interpretability of the questions.

The feedback obtained from the pilot survey and interviews informed the refinement of the questionnaire, ensuring it was optimized for the larger-scale survey. To assess the reliability of the survey instruments, Cronbach's alpha was employed. This statistical measure evaluates the internal consistency of the constructs, providing a reliable gauge of the instruments' robustness. The pilot study's results demonstrated Cronbach's alpha values exceeding 0.6 for all constructs, which is widely regarded as the threshold for acceptable reliability. This affirmed that the survey instruments were well-suited for capturing the data required for this research.

The sampling frame for this study comprised students enrolled in environmental-related economics courses, specifically "Environmental Economics" (ECO646) and "Economic Policies and Issues" (ECO649), within the Business Economics (BA250) bachelor degree program at Universiti Teknologi MARA (UiTM) Cawangan Kedah. These courses were selected because they provide a direct connection to the research theme of environmental sustainability, ensuring that the respondents have at least some foundational exposure to the concepts under investigation. The total student population at UiTM Kedah in 2024 stood at 8,224, offering a broad and diverse pool of potential respondents.

The data collection process spanned three academic semesters from 2023 to 2024, during which a total of 256 questionnaires were distributed to students enrolled in the targeted courses. This approach allowed the research to capture a more representative sample across different cohorts, minimizing potential biases associated with semester-specific factors. Out of the 256 distributed questionnaires, 198 were returned with complete responses, yielding a valid response rate of approximately 77.3%. This robust response rate underscores the students' engagement with the research and provides a solid foundation for the subsequent analysis.

The unit of analysis for this study is the individual student, with each respondent providing unique insights into their knowledge, attitudes, and behaviors related to environmental sustainability. By focusing on individual-level data, the study is able to explore the nuanced relationships between the variables of interest, such as knowledge, reasons for engaging in environmental sustainability, attitudes, willingness to act, and potential hesitations.

The research design also incorporated strategies to ensure data quality and mitigate potential biases. For instance, the questionnaire's structure was carefully organized to facilitate ease of understanding and prevent respondent fatigue. Questions were grouped thematically, with clear instructions provided for each section. Additionally, the use of both close-ended and Likert-scale questions allowed for the collection of quantitative data while also capturing the respondents' perceptions and attitudes in a structured manner.

The demographic diversity of the respondents added depth to the study, as it included students from various socioeconomic and cultural backgrounds. This diversity is particularly relevant given the study's focus on environmental sustainability, a topic influenced by individual values, cultural norms, and prior exposure to environmental issues. By sampling from a population with such varied perspectives, the study ensures a more comprehensive understanding of the factors driving or hindering engagement in environmental sustainability among students. Moreover, the inclusion of a pilot study and the iterative refinement of the questionnaire demonstrate the research's commitment to methodological rigor. These steps not only enhanced the reliability of the data collection instruments but also ensured that the questions were contextually relevant and resonated with the respondents. The pilot study served as a critical testing ground, allowing the researchers to identify and address potential issues before the full-scale survey was launched. The use of Cronbach's alpha to assess the reliability of the constructs further underscores the methodological robustness of the study.

In summary, the quantitative approach in this study, centered on a meticulously designed and validated survey questionnaire, provides a solid foundation for exploring the factors influencing environmental sustainability among students. The rigorous verification process, involving expert review, pilot testing, and iterative refinement, ensures the reliability and validity of the survey instruments. The thoughtful sampling strategy, combined with the focus on individual-level analysis, enables the study to capture diverse perspectives and contribute valuable insights to the discourse on environmental sustainability in higher education. By leveraging a systematic and

methodologically sound approach, this research offers a comprehensive examination of the complex interplay between knowledge, religiosity, and policies on the changes in behaviour in the context of environmental sustainability.

3.2 Measures

This study investigates the factors contributing to behavioral changes toward environmental sustainability by examining the roles of knowledge, religiosity, and policies, rules, and regulations. These factors are mediated by subjective norms, which reflect the social pressures and expectations influencing individual behaviors. To capture respondents' perceptions accurately, all constructs utilize a uniform response format: a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). This standardized approach ensures consistency and comparability across constructs. The constructs themselves were carefully adapted and consolidated to align with the study's objectives, providing a comprehensive framework for understanding behavioral changes within the university context.

Behavioural changes toward environmental sustainability, is loosely based on the theory of norm activation, theory of social change and theory of planned behaviour. By integrating established theoretical underpinnings with tailored measures, the research aims to provide new insights into how university students' attitudes and external influences shape their engagement with environmental sustainability efforts.

4. Results

For the measurement model, internal consistency was rigorously assessed using Cronbach's alpha and composite reliability. Table 1 illustrates that the Cronbach's alpha and composite reliability values for all constructs exceed the recommended threshold of 0.8, as suggested by Nunnally (1978), thus affirming internal consistency. To establish convergent validity, two key criteria were examined: the outer loadings of the indicators, which should be greater than 0.7, and the average variance extracted (AVE), which should exceed 0.5, as per the guidelines provided by Hair et al. (2017). Table 1 confirms that all constructs meet these criteria, with outer loadings surpassing the 0.7 threshold and AVE values ranging from 0.869 to 0.979, providing robust evidence of convergent validity. Constructs with outer loadings below the acceptable limit, such as BE2 and SN5, were excluded from the model to ensure precision. Figure 2 further supports these findings by showcasing the measurement model, where all factor loadings are above 0.819, corroborating the constructs' internal consistency and validity.

Based on Table 2, discriminant validity was evaluated using two complementary methods: the Fornell-Larcker criterion and the Heterotrait-Monotrait ratio (HTMT). The HTMT criterion, grounded in the work of Henseler et al. (2015), stipulates that the value between two constructs should remain below 0.85, while Kline (2011) recommends a stricter threshold of 0.5. Table 2 demonstrates that the HTMT values for all constructs fall between 0.142 and 0.726, well within the acceptable range, thereby fulfilling the discriminant validity requirement. Additionally, the Fornell-Larcker criterion asserts that the square root of the AVE for each construct should exceed the inter-construct correlations. Table 2 shows values ranging from 0.40 to 0.949, consistently meeting this standard. Together, these results confirm that the measurement model satisfies all discriminant validity concerns, ensuring the reliability and robustness of the constructs used in this study.

*Table 1
Measurement Model*

Constructs	Items	Outer Loadings	Cronbach's Alpha	Composite Reliability	AVE	f²
Behavioural Change	BE1	0.965	0.963	0.964	0.973	0.900
	BE3	0.939				
	BE4	0.936				
	BE5	0.955				
	KN1	0.876				
Knowledge	KN2	0.928	0.915	0.924	0.940	0.798
	KN3	0.926				
	KN4	0.840				
	PRR1	0.848				
Policy, Rules & Regulations	PRR2	0.821	0.773	0.775	0.869	0.688
	PRR3	0.819				
	RE1	0.912				
Religiosity	RE2	0.906	0.92	0.936	0.943	0.805
	RE3	0.880				
	RE4	0.890				
	SN1	0.983				
Subjective Norms	SN2	0.961	0.972	0.974	0.979	0.923
	SN3	0.955				
	SN4	0.942				

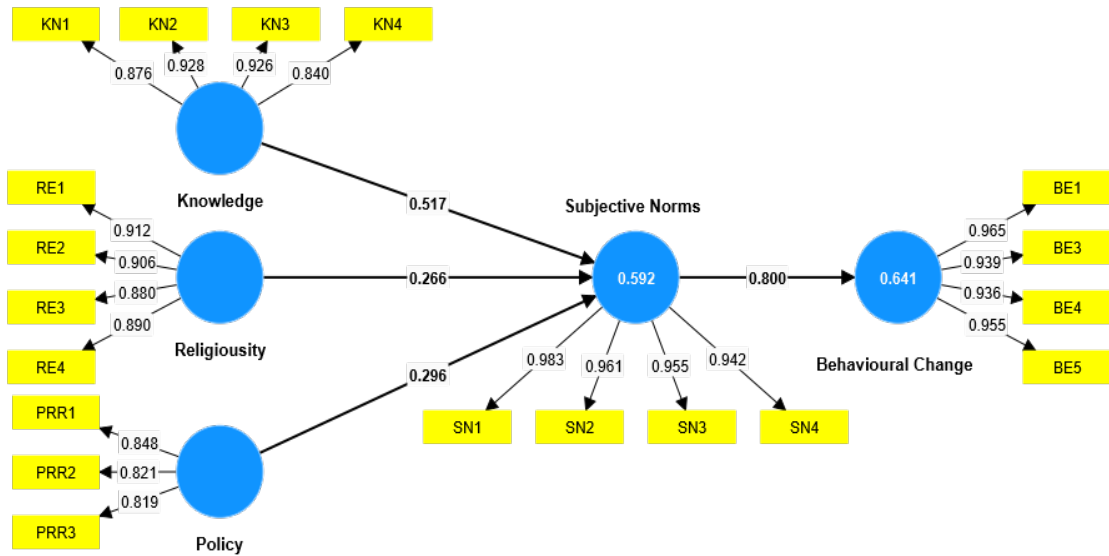


Figure 2. Measurement Model

Table 2
Discriminant Analysis

HTMT	Behavioural Change	Knowledge	Policy	Religiosity	Subjective Norms
Behavioural Change					
Knowledge	0.697				
Policy	0.649	0.654			
Religiosity	0.305	0.071	0.142		
Subjective Norms	0.726	0.707	0.686	0.270	
Fornell-Larcker	Behavioural Change	Knowledge	Policy	Religiosity	Subjective Norms
Behavioural Change	0.949				
Knowledge	0.658	0.893			
Policy	0.819	0.555	0.830		
Religiosity	0.291	0.040	0.049	0.897	
Subjective Norms	0.800	0.671	0.596	0.260	0.961

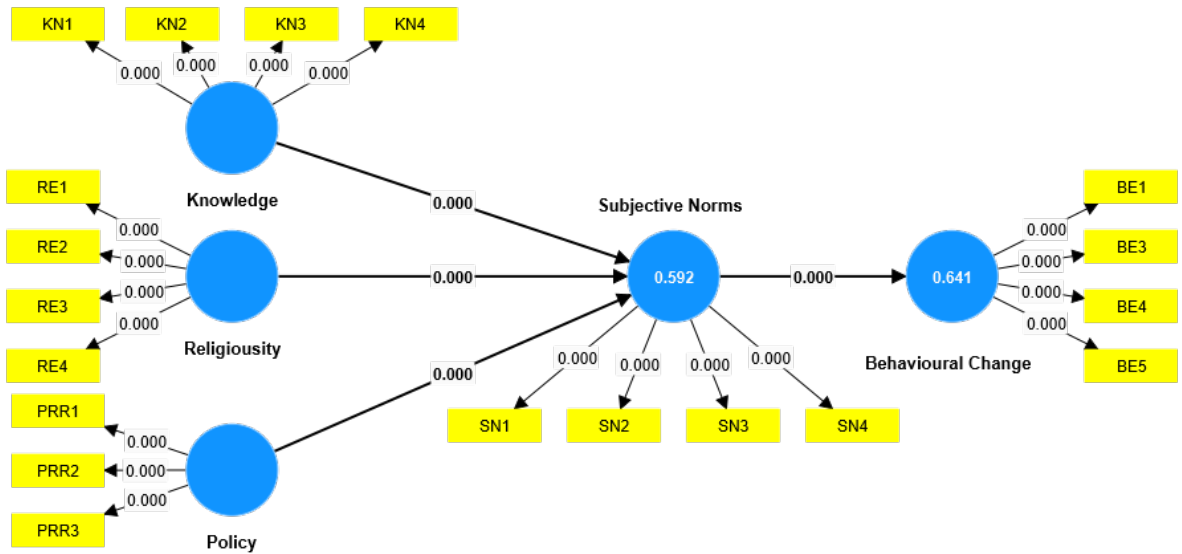


Figure 3. Structural Model

To evaluate the significance of the coefficient paths within the structural model, a bootstrapping technique with 10,000 resamples was applied. This robust statistical method enhances the reliability of the results by generating a distribution of estimates to test the significance of relationships. Table 3 presents the findings for both direct and total effects, highlighting how each construct influences behavioral changes toward environmental sustainability.

For the direct effects, the results reveal that knowledge, religiosity, policies, rules, and regulations, as well as subjective norms, all have a significant positive impact on behavioral changes toward environmental sustainability. These findings underscore the importance of these constructs as direct predictors of pro-environmental behavior. When examining the total effects, the results indicate that subjective norms play a crucial mediating role, reinforcing the direct effect findings. Subjective norms serve as an intermediary through which other constructs exert their influence on behavioral change. Specifically, knowledge, religiosity, and policies, rules, and regulations significantly affect subjective norms, which, in turn, positively impact behavioral changes toward environmental sustainability. This mediating role highlights the importance of social and cultural pressures in shaping individual behavior.

Overall, the results emphasize the interconnectedness of these constructs, demonstrating a holistic framework for understanding the drivers of environmental sustainability behaviors. These insights provide actionable pathways for designing interventions and policies aimed at fostering environmental stewardship. Figure 3 illustrates the structural model.

Table 3
Structural Model

Direct Effect	Coefficient	Standard Error	t-stats	p-values
Knowledge -> Subjective Norms	0.515	0.077	6.678	0.000
Policy -> Subjective Norms	0.298	0.077	3.824	0.000
Religiosity -> Subjective Norms	0.264	0.056	4.761	0.000
Subjective Norms -> Behavioural Change	0.799	0.047	17.006	0.000
Total Effect	Coefficient	Standard Error	t-stats	p-values
Knowledge -> Behavioural Change	0.412	0.068	6.059	0.000
Knowledge -> Subjective Norms	0.515	0.077	6.678	0.000
Policy -> Behavioural Change	0.240	0.069	3.457	0.000
Policy -> Subjective Norms	0.298	0.077	3.824	0.000
Religiosity -> Behavioural Change	0.211	0.046	4.636	0.000
Religiosity -> Subjective Norms	0.264	0.056	4.761	0.000
Subjective Norms -> Behavioural Change	0.799	0.047	17.006	0.000

To evaluate the causal-predictive ability of the constructs, a PLS Predict analysis was conducted. Alongside assessing the significance of path coefficients, the predictive power of the model was examined by analyzing the coefficient of determination (R^2) values of the endogenous constructs, as recommended by Hair et al. (2017). The results demonstrated that the model accounted for 64.1% of the variance in BE and 59.2% of the variance in SN, indicating substantial explanatory power.

Additionally, a blindfolding procedure with an omission distance of $k=10$ was performed to calculate the Stone-Geisser's Q^2 values. The Q^2 values for BE and SN were found to be 0.668 and 0.57, respectively. Since both values exceed zero, the research model was confirmed to possess predictive relevance.

Furthermore, a detailed PLS Predict analysis, as outlined by Shmueli et al. (2016), was carried out. Table 4 illustrates that the Q^2 predict values for BE and SN are greater than zero, indicating that the prediction error in the PLS-SEM results is lower than that of the mean values. When compared to a naive linear regression model (LM), the PLS benchmark demonstrated lower prediction errors, as measured by RMSE or MAE, across most indicators. These findings suggest that the model exhibits medium predictive power, further validating its utility in understanding and predicting behavioral outcomes.

Table 4
PLS Predict

	Q ² predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE
BE1	0.630	0.404	0.286	0.302	0.225
BE3	0.616	0.436	0.312	0.339	0.248
BE4	0.556	0.452	0.327	0.389	0.282
BE5	0.602	0.456	0.327	0.41	0.297
SN1	0.576	0.435	0.284	0.439	0.293
SN2	0.548	0.481	0.316	0.489	0.329
SN3	0.506	0.448	0.303	0.453	0.317
SN4	0.461	0.499	0.336	0.506	0.352

Robustness Check

To ensure the robustness and validity of the results, three diagnostic tests were performed. Firstly, a Confirmatory Tetrad Analysis (CTA) was conducted to determine whether the constructs were reflective or formative in nature. The findings, as presented in Table 5, indicate that the majority of the results are statistically insignificant, thereby confirming the reflective nature of the items used in the model.

Secondly, to assess the potential issue of endogeneity within the model, the Gaussian Copula method was employed. The results, illustrated in Figure 4, reveal no significant effects, thereby indicating the absence of endogeneity problems in the data. This finding supports the reliability of the model's estimations and causal inferences.

Lastly, the issue of nonlinearity was examined using the Quadratic Effect Test. As depicted in Figure 5, the results indicate that the constructs of knowledge (KE) and religiosity (RE) exhibit nonlinearity. This observation suggests that the relationships involving these variables may not follow a strictly linear pattern, warranting further investigation or potential model adjustments to address these nonlinear effects effectively.

Table 5
Confirmatory Tetrad Analysis

Construct	Coefficient	Standard Error	p-values	Bias	CI low	CI up
Knowledge						
1: KN1,KN2,KN3,KN4	0.021	0.01	0.025	0.000	0.003	0.041
2: KN1,KN2,KN4,KN3	0.037	0.009	0.136	-0.001	0.019	0.056
Behavioural Change						
1: BE1,BE3,BE4,BE5	0.011	0.007	0.149	0.000	-0.004	0.025
2: BE1,BE3,BE5,BE4	0.013	0.008	0.088	0.000	-0.002	0.028
Religiosity						
1: RE1,RE2,RE3,RE4	0.101	0.02	0.251	-0.001	0.066	0.143

2: RE1,RE2,RE4,RE3	0.076	0.022	0.232	-0.001	0.036	0.121
<i>Subjective Norms</i>						
1: SN1,SN2,SN3,SN4	-0.006	0.003	0.112	0.000	-0.012	0.000
2: SN1,SN2,SN4,SN3	-0.006	0.003	0.069	0.000	-0.012	0.000

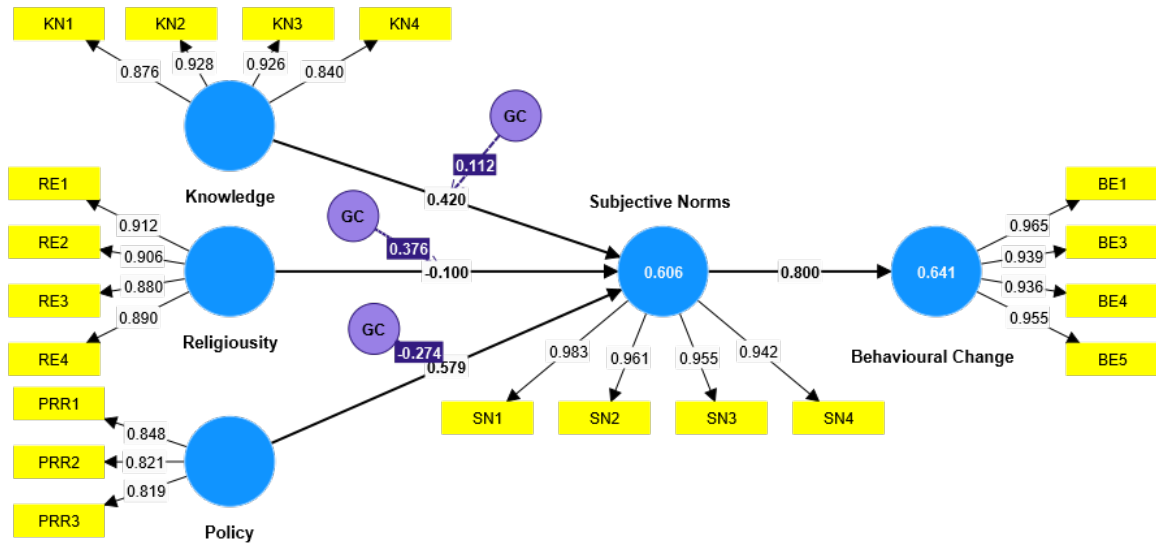


Figure 4. Test for Endogeneity – Gaussian Copula

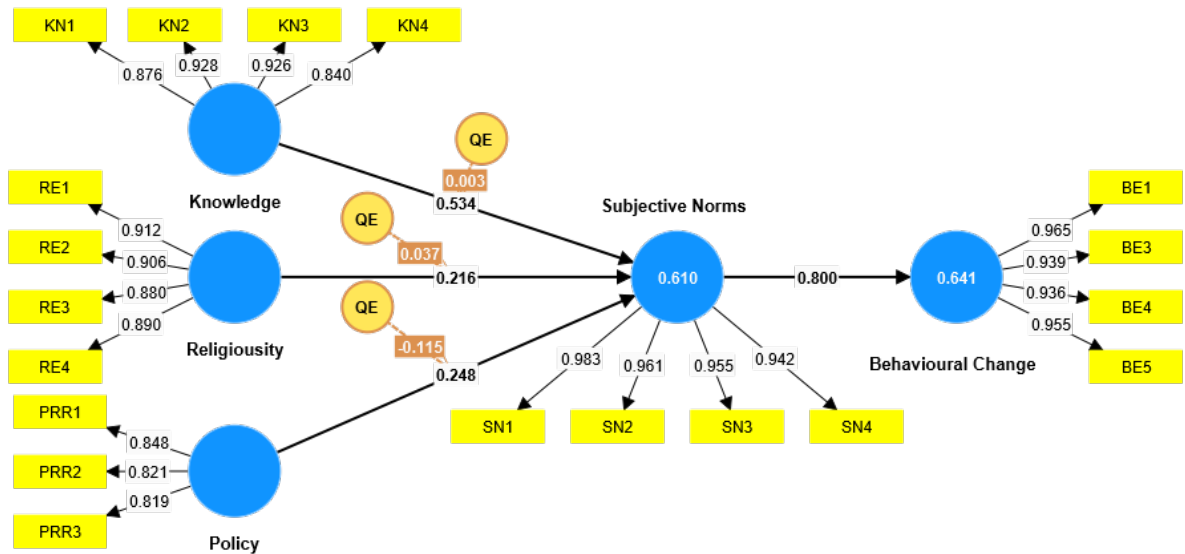


Figure 5. Test for Nonlinearity – Quadratic Effect

5. Discussion

The findings of this study highlight the significant positive effect of knowledge on behavioral changes toward environmental sustainability. Specifically, students who are aware of the detrimental effects of environmental pollution and degradation are more likely to modify their behavior in favor of conservation efforts. This result aligns with prior studies, which have consistently demonstrated that knowledge plays an important role in fostering green behavioral changes. Contextually, the more individuals are exposed to information about the severity of environmental degradation, the greater their propensity to engage in environmentally responsible actions, such as recycling or purchasing green products. The observed positive relationship between knowledge and behavioral change also extends to its connection with subjective norms. Awareness of the adverse consequences of environmental degradation not only influences intrinsic motivation but also shapes societal expectations, thereby fostering collective action.

Religiosity emerged as another significant factor influencing behavioral changes toward environmental sustainability. As the respondents in this study were all Muslim, their understanding of environmental stewardship, as emphasized in the Quran, likely motivated their pro-environmental behaviors. This sense of moral and spiritual responsibility translated into concrete actions such as recycling, reducing food waste, and conserving energy by switching off unused lights. These findings align with existing literature suggesting that religious teachings often instill a sense of duty toward environmental preservation. The role of religiosity in shaping behavior underscores the importance of integrating spiritual and ethical dimensions into environmental education and advocacy efforts.

The study also underscores the role of social norms as a mediating variable in promoting behavioral changes. Social norms favouring environmental sustainability were found to significantly influence students' actions. This finding is supported by De Groot and Steg (2009), who identified that individuals who perceive a sense of responsibility in challenging situations often experience feelings of guilt, which, in turn, drive their actions. The interplay between social norms and intrinsic motivation highlights the importance of community-driven initiatives in fostering pro-environmental behavior.

Policies, rules, and regulations constitute the third factor examined in this study and were shown to significantly impact both subjective norms and behavioral changes. Efforts such as awareness campaigns, regulations mandating waste recycling, the establishment of more recycling centers, and the availability of affordable green product alternatives have collectively enhanced accessibility and choice for environmentally responsible actions. These measures not only facilitate ethical consumer behavior but also create social pressures that compel individuals to adopt conservation-oriented practices. The increased availability and affordability of green products, coupled with regulatory support, amplify consumers' ethical obligations and translate into tangible behavioral changes.

Additionally, the mediating role of subjective norms was assessed, revealing that subjective norms effectively mediate the relationships between knowledge, religiosity, and policies, rules, and regulations with behavioral changes. While all three factors independently influence behavioral changes, the inclusion of subjective norms as a mediating variable further accentuates their effects, illustrating the interconnectedness of individual, societal, and institutional influences on environmental behavior.

Despite these insights, the study has a few limitations. Firstly, the sample was confined to students enrolled in environmental-related courses within the Faculty of Business Management at Universiti

Teknologi MARA Cawangan Kedah only. Future research should consider expanding the sample to include the general public to enhance the generalizability of the findings. Secondly, the use of cross-sectional data, albeit collected over three semesters, limits the ability to draw causal inferences. Longitudinal studies are recommended for future research to better capture the dynamics of behavioral changes over time. Addressing these limitations will provide a more comprehensive understanding of the factors driving environmental sustainability behaviors and strengthen the applicability of the findings to broader contexts.

6. Conclusion

This study has highlighted the intricate interplay of knowledge, religiosity, and policy frameworks, mediated by subjective norms, in influencing behavioral changes toward environmental sustainability. The findings emphasize that fostering environmentally responsible behaviors requires a multi-dimensional approach that integrates education, cultural values, and regulatory mechanisms.

Knowledge emerged as a critical driver of pro-environmental behaviors, reinforcing the idea that individuals equipped with an understanding of the adverse effects of environmental degradation are more likely to adopt sustainable practices. This underscores the importance of comprehensive environmental education programs that not only disseminate information but also inspire action through critical awareness and decision-making skills.

Religiosity, particularly within the context of Islamic teachings, was found to significantly influence environmental behaviors. Core principles such as stewardship, moderation, and the prohibition of wastefulness serve as moral imperatives that resonate with sustainable living. The study highlights the underexplored potential of integrating religious values into environmental advocacy, demonstrating how spiritual teachings can inspire practical actions such as recycling, energy conservation, and reduced consumption. This finding calls for a greater emphasis on leveraging cultural and spiritual dimensions in environmental initiatives, particularly in Muslim-majority contexts.

Policy interventions, including regulations, awareness campaigns, and incentives for sustainable practices, were shown to play a pivotal role in shaping behaviors. The study reaffirms that well-structured policies, when aligned with societal norms and cultural values, can enhance accessibility and motivation for adopting green practices. For instance, making green products affordable and available while enforcing waste recycling policies creates an enabling environment for behavioral change.

The mediating role of subjective norms was also significant, demonstrating the power of social expectations and community-driven initiatives in promoting pro-environmental actions. This finding suggests that collective action and societal pressures can amplify the effects of individual knowledge and values, creating a ripple effect that drives broader behavioral shifts.

While the study offers valuable insights, its scope is limited to university students enrolled in environmental-related courses at Universiti Teknologi MARA Cawangan Kedah. Future research should expand to include diverse demographic groups to enhance the generalizability of findings. Additionally, the cross-sectional design limits causal inferences; longitudinal studies are recommended to capture the evolving dynamics of behavioral change over time.

In conclusion, this study provides a comprehensive framework for understanding the drivers of behavioral changes toward environmental sustainability. By integrating theoretical insights from the Theory of Planned Behavior and Norm Activation Theory, it offers a robust model for designing

interventions that leverage education, religiosity, and policy frameworks. These findings contribute to the growing discourse on sustainability and provide actionable recommendations for policymakers, educators, and community leaders seeking to foster a green lifestyle. Addressing environmental challenges requires a holistic approach that aligns individual values with societal norms and institutional support, paving the way for a sustainable future.

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EXPLORING CULTURAL AND CREATIVE PRODUCT DESIGN THROUGH DETERMINING THE SIGNIFICANCE CHARACTERISTICS OF HONGSHAN POTTERY PATTERN

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ABSTRACT

Hongshan Culture is one of China's precious cultural heritages and is among the most renowned archaeological cultures of the Neolithic era in Northeast China. Among the unearthed artifacts from the Hongshan Culture, pottery stands out as a typical item, offering insights into the aesthetic views, primitive religious beliefs, and cultural characteristics of the Hongshan Culture period. This holds significant academic value. In comparison to theoretical achievements in studying Hongshan Culture patterns, research on creative product design inspired by Hongshan Culture is relatively scarce. The primary aim of this study is to identify the significance characteristics of Hongshan Culture pottery patterns, thereby sparking reflections on incorporating these unique and typical patterns into creative product design. Through expert interviews, this research comprehensively explores seven aspects of Hongshan Culture pottery patterns: cultural significance, totem worship, religious beliefs, philosophy significance, auspicious significance, significant characteristics patterns, and their application in cultural and creative product design. The study ultimately defines the significance characteristics of Hongshan Culture pottery patterns and provides design suggestions for integrating these classic patterns into creative product designs.

1. Introduction

In the late Neolithic period of China, the Hongshan culture stands as a significant cultural form, with its distinctive pottery patterns being a focal point of scholarly attention. These visual patterns, rich in color and steeped in cultural significance, are crucial for a profound understanding in the context of "the significance characteristics of Hongshan Culture pottery pattern." This section of the study aims to delve deeply into the significance characteristics of Hongshan culture pottery patterns. Through the utilization of expert interviews, a comprehensive investigation unfolds across different dimensions, exploring its cultural significance, totem worship, religious beliefs, philosophical significance, auspicious significance, significance characteristics patterns, and application in cultural and creative product design. Employing qualitative analysis software, Nvivo 12 Plus, a systematic analysis of expert interview records has been conducted to uncover the profound cultural implications embedded within the pottery patterns of Hongshan culture.

2. Methodology

In 1967, Glazer and Strauss introduced Grounded Theory (Group Theory) (Glazer, Barney & Anselm Strauss, 1967). Unlike traditional approaches to constructing theoretical models, Grounded Theory adopts a bottom-up approach where researchers commence with raw data. They engage in a systematic coding analysis to integrate concepts, categories, and logical relationships between categories reflecting events or phenomena, culminating in the development of the final theoretical model. Grounded Theory, as a research methodology, operates based on two fundamental principles: "emergence" and "constant comparative analysis." At the initiation of the study, researchers typically possess vague research questions or research areas lacking theoretical underpinnings. Conceptual categories naturally emerge during data analysis, forming the basis for constructing the theoretical model. Simultaneously, the research must maintain a close association between theory and data. The coding process is conducted synchronously and iteratively. Through "constant comparative analysis," connections between conceptual categories are identified, until developing the theory.

3. Results

In this study, qualitative analysis software Nvivo 12 Plus was predominantly employed to perform tasks such as project setup, text coding, node organization, text classification, and data visualization on the organized interview records. Nvivo 12 Plus stands out as a robust qualitative analysis software capable of in-depth processing and analysis of various types of raw materials, including text, survey questionnaires, images, audio-visual materials, field notes, and web pages. This facilitates researchers in evaluating data and designing methods for assessing and establishing coding models (JiangXin, 2020). In the actual analysis process, this study drew on Nvivo 12 Plus, applying the selective coding approach from Grounded Theory to meticulously code approximately three-fourths of the interview materials verbatim.

3.1 Opening Coding

In this study, the original interview transcripts of three participants were meticulously coded on a sentence-by-sentence basis, involving three sequential steps: labeling, conceptualization, and categorization. Given that labeling and conceptualization were almost simultaneous and the expressions were closely related, the opening coding table (Table 1) only displays categorization. Conceptualization was primarily based on the participants' original language and researcher-generated concepts, aiming to accurately reveal the true meanings expressed by the participants. Further categorization of concepts was conducted on this basis.

During open coding, the researcher coded each sentence of the interview transcripts, resulting in a total of 78 initial codes. Considering the research theme of "significance characteristics of the visual patterns on Hongshan culture" and the complexity of the initial conceptualizations with some degree of overlap, the researcher employed functions such as node filtering, restructuring, and merging in Nvivo 12 Plus software to iteratively summarize and refine these initial codes. This involved removing codes that deviated from the research theme nodes and merging duplicate nodes. Based on this process, an initial set of 50 categories frequently mentioned by the participants was formed, such as "Production and Daily Life," "Reproductive Worship," "Evidence of Civilizational Emergence," "Manifestation of the Emergence of Ritual System," "Expression of Material Culture," "Totems are Endowed with Divinity," "Symbolization," "Fixation," and others, marked as free nodes. Table 1 illustrates representative excerpts from the original interview transcripts and initial conceptualizations corresponding to these categories.

*Table 1
Opening Coding*

Text Source	Example of Interview Record	Categorization
Expert 1	The cultural significance emanates from the practicalities of production and daily life, giving rise to a sense of form, color, and configuration within these practical experiences. Pottery patterns, as a reflection, embody the earliest aesthetic conceptions of humanity, seamlessly amalgamating utility and aesthetics in a perfect synthesis.	Production and daily life
Expert 1	In order to imbue themselves with the robust reproductive abilities of certain animals and plants, the Hongshan ancestors depicted them as patterns on pottery surfaces, reflecting the early human inclination toward reproductive worship.	Reproductive worship
Expert 2	The pottery patterns of the Hongshan culture serve as tangible evidence of the representative origins of civilization. The state of civilization within the Hongshan culture has attained a certain level of sophistication.	Evidence of civilizational emergence
Expert 2	Pottery is extensively employed in sacrificial rituals, and the pottery patterns therein represent the subjective thoughts of the ancestors, ultimately giving rise to ritual systems.	Manifestation of the emergence of ritual system
Expert 3	The Hongshan culture encompasses material culture, spiritual culture, and institutional culture. The patterns on pottery, in the form of pottery designs, serve as a manifestation of material culture on the surface of the pottery.	Embodiment of material culture
Expert 1	Totem worship has transcended the worship of the animals themselves; it is now a reverence for the significance attributed to them by the ancestors, moving beyond the tangible worship of totems.	Totems are endowed with divinity
Expert 3	Analyzing the pottery patterns of the Hongshan culture from the perspective of totem worship reveals a process involving symbolization, centralization, fixation, and sanctification. The pottery patterns serve as a reflection and manifestation of the genesis, development, and evolution of totem worship.	Symbolization
Expert 3	Analyzing the pottery patterns of the Hongshan culture from the perspective of totem worship reveals a process involving symbolization, centralization, fixation, and sanctification. The pottery	Fixation

	patterns serve as a reflection and manifestation of the genesis, development, and evolution of totem worship.	
Expert 3	Analyzing the pottery patterns of the Hongshan culture from the perspective of totem worship reveals a process involving symbolization, centralization, fixation, and sanctification. The pottery patterns serve as a reflection and manifestation of the genesis, development, and evolution of totem worship.	Centralization
Expert 3	Analyzing the pottery patterns of the Hongshan culture from the perspective of totem worship reveals a process involving symbolization, centralization, fixation, and sanctification. The pottery patterns serve as a reflection and manifestation of the genesis, development, and evolution of totem worship.	Sanctification
Expert 1	Religious beliefs originated based on agricultural activities, thus creating a close correlation between agricultural production and religious beliefs. This correlation is ultimately manifested in the form of patterns on the surface of pottery.	Agricultural activities
Expert 2	The ideological foundation of "revering the heavens and ancestors" is rooted in the spiritual strength of the ancient people. In that primordial society where spiritual power held immense sway, religious beliefs served as a robust pillar and formidable reliance for the survival of the ancient people. The pottery patterns created by the Hongshan ancestors evidently bear profound religious devotion, embodying boundless hope.	"Reverence for heaven and ancestors"
Expert 3	The pattern system serves as an expression of the religious belief system, representing a process from individual to group, group to inheritance, inheritance to refinement, culminating in the formation of an essence. After undergoing highly abstract processes, this essence is summarized into a core.	Individual
Expert 3	The pattern system serves as an expression of the religious belief system, representing a process from individual to group, group to inheritance, inheritance to refinement, culminating in the formation of an essence. After undergoing highly abstract processes, this essence is summarized into a core.	Group
Expert 3	The pattern system serves as an expression of the religious belief system, representing a process from individual to group, group to inheritance, inheritance to refinement, culminating in the formation of an essence. After undergoing highly abstract processes, this essence is summarized into a core.	Inheritance
Expert 3	The pattern system serves as an expression of the religious belief system, representing a process from individual to group, group to inheritance, inheritance to refinement, culminating in the formation of an essence. After undergoing highly abstract processes, this essence is summarized into a core.	Highly abstract
Expert 3	It is possible to explore and unearth the formation, development, and changes of the religious belief system in the Hongshan culture through an examination of its pattern system.	The pattern system is an expression of the religious belief system
Expert 1	The ancient people, in their perception of the myriad elements in the natural world, discerned varying changes with different seasons. Through rational observation and synthesis of these phenomena,	Rational refinement of cognition

	they manifested philosophical significance in their understanding of the world.	
Expert 2	The philosophical dialectical thinking of traditional Yin-Yang culture is reflected in the pottery patterns of the Hongshan culture.	"Yin-Yang culture"
Expert 2	"Unity of Heaven and Humanity" represents an ancient cosmic worldview, and the Hongshan culture constitutes a significant origin of this philosophical concept.	"Unity of Heaven and Humanity"
Expert 3	Examining the pottery patterns of the Hongshan culture allows us to discern the concepts held by the ancient people and the objective world they encountered.	The objectification of subjective world
Expert 1	The frog pattern in the Xinglongwa culture symbolizes abundance, and in today's society, frogs are also associated with abundance.	Frog pattern
Expert 1	The bird pattern in the Zhaobaogou culture may perhaps be linked to the contemporary auspicious symbolism of the phoenix.	Bird pattern
Expert 1	The interconnected whirlpool pattern, if representing the meaning of water, can also be seen as a symbol of auspiciousness in modern society.	Interconnected whirlpool pattern
Expert 2	The jade dragon and jade phoenix in the Hongshan culture represent typical auspicious symbols in China. Examining the pottery patterns, for example, the use of red pigments, reveals elements that continue to symbolize auspicious meanings even in modern society.	The use of red pigment
Expert 3	The patterns reflect a harmonious environment, encompassing the harmony of individuals and society, emphasizing the unity of heaven, earth, and humanity.	Environmental Harmony
Expert 3	They are based on the progress of production and life, signifying advancements in both. The patterns themselves undergo changes, reflecting an elevation in the standard of living.	Progress in Production
Expert 3	The third aspect indicates an improvement in the inherent qualities of individuals. In the early stages, patterns were simple and clumsy, while in later stages, they became more fluent and magnificent, showcasing an enhancement in people's qualities and perspectives. Therefore, the harmonious environment, progress in production, improvement in living standards, population growth, and elevated qualities collectively demonstrate the auspicious nature of the pottery patterns in the Hongshan culture.	Improvement of Life
Expert 3	Therefore, the harmonious environment, progress in production, improvement in living standards, population growth, and elevated qualities collectively demonstrate the auspicious nature of the pottery patterns in the Hongshan culture.	Population growth
Expert 3	Therefore, the harmonious environment, progress in production, improvement in living standards, population growth, and elevated qualities collectively demonstrate the auspicious nature of the pottery patterns in the Hongshan culture.	Improvement of Quality
Expert 3	In my opinion, the most fitting patterns include three: Scalelike pattern, Bird pattern, and Hook-shaped pattern.	Bird pattern
Expert 1	One of the most typical patterns in the pottery designs of the Hongshan culture is the "Z"-shaped pattern. Triangular and diamond patterns also hold significant importance, as do the interconnecting whirlpool patterns (floral patterns) and scalelike patterns.	Interconnected whirlpool pattern

Expert 1	One of the most typical patterns in the pottery designs of the Hongshan culture is the "Z"-shaped pattern. Triangular and diamond patterns also hold significant importance, as do the interconnecting whirlpool patterns (floral patterns) and scalelike patterns.	"Z"shaped pattern
Expert 1	One of the most typical patterns in the pottery designs of the Hongshan culture is the "Z"-shaped pattern. Triangular and diamond patterns also hold significant importance, as do the interconnecting whirlpool patterns (floral patterns) and scalelike patterns.	Triangle pattern
Expert 1	One of the most typical patterns in the pottery designs of the Hongshan culture is the "Z"-shaped pattern. Triangular and diamond patterns also hold significant importance, as do the interconnecting whirlpool patterns (floral patterns) and scalelike patterns.	Diamond pattern
Expert 1	One of the most typical patterns in the pottery designs of the Hongshan culture is the "Z"-shaped pattern. Triangular and diamond patterns also hold significant importance, as do the interconnecting whirlpool patterns (floral patterns) and scalelike patterns.	Scalelike pattern
Expert 2	The continuous use of two-sided and four-sided is distinctive in the pottery patterns of the Hongshan culture. Wide-band patterns, "回" shaped patterns, and Hook-shaped patterns are all characteristic designs that reflect the unique features of the Hongshan culture.	Continuous two-sided pattern
Expert 2	The continuous use of two-sided and four-sided is distinctive in the pottery patterns of the Hongshan culture. Wide-band patterns, "回" shaped patterns, and Hook-shaped patterns are all characteristic designs that reflect the unique features of the Hongshan culture.	Continuous four-sided pattern
Expert 2	The continuous use of two-sided and four-sided is distinctive in the pottery patterns of the Hongshan culture. Wide-band patterns, "回" shaped patterns, and Hook-shaped patterns are all characteristic designs that reflect the unique features of the Hongshan culture.	Wide-band pattern
Expert 2	The continuous use of two-sided and four-sided is distinctive in the pottery patterns of the Hongshan culture. Wide-band patterns, "回" shaped patterns, and Hook-shaped patterns are all characteristic designs that reflect the unique features of the Hongshan culture.	"回"shaped pattern
Expert 2	The continuous use of two-sided and four-sided is distinctive in the pottery patterns of the Hongshan culture. Wide-band patterns, "回" shaped patterns, and Hook-shaped patterns are all characteristic designs that reflect the unique features of the Hongshan culture.	Hook-shaped pattern
Expert 1	Don't just copy patterns	Don't just copy patterns
Expert 1	It is necessary to have a good extraction and design of the pattern, which must be combined with modern aesthetics.	Integrating patterns with modern aesthetics
Expert 1	Breaking the taboo of many modern people that many prehistoric artifacts are from tombs, delving into the meaning of the patterns themselves, and combining them with modern thinking can create cute or more acceptable designs for modern people.	Break taboos
Expert 2	In the realm of design, it is crucial to integrate traditional patterns with modern aesthetics. The extraction and inheritance of "form," the absorption and extension of "meaning," and the acquisition and sublimation of "spirit" are pivotal aspects.	Extraction and inheritance of "Form"

Expert 2	In the realm of design, it is crucial to integrate traditional patterns with modern aesthetics. The extraction and inheritance of "form," the absorption and extension of "meaning," and the acquisition and sublimation of "spirit" are pivotal aspects.	Assimilation and extension of "Meaning"
Expert 2	In the realm of design, it is crucial to integrate traditional patterns with modern aesthetics. The extraction and inheritance of "form," the absorption and extension of "meaning," and the acquisition and sublimation of "spirit" are pivotal aspects.	Attainment and Sublimation of "Spirit"
Expert 2	It is imperative not to confine oneself to a singular perspective but rather strive for a holistic representation. The combination of ancient symbols and elements with contemporary aesthetics is encouraged.	Overall reflection
Expert 3	Endeavors have been made to produce designs that transcend national boundaries and various cultures. These designs are characterized by creativity, novelty, and a close connection to various cultures within the Hongshan complex.	Design beyond national and cultural boundaries
Expert 3	They successfully integrate traditional patterns with modern aesthetics, utilizing ancient elements in a contemporary transformation.	Using ancient elements for modern transformation

3.2 Axial Coding

Axial coding involves discovering and establishing various connections between independent categories, exploring potential logical relationships among categories, and thereby constructing the main and sub-categories of this research. Building upon opening coding, researchers repeatedly scrutinized the connotations of 50 initial codes, merging and classifying categories that were semantically related. Ultimately, 40 main categories were formed, as shown in Table 2. Categories such as "Production and daily life," "Reproductive Worship," "Evidence of Civilizational Emergence," "Manifestation of the Emergence of Ritual System," and "Expression of Material Culture" were classified under the main category "Cultural Significance." Similarly, categories like "Symbolization," "Fixation," "Centralization," and "Sanctification" were grouped under the main category "Symbolization → Centralization → Fixation → Sanctification." Additionally, categories such as "Individual," "Group," "Inheritance," and "High Abstraction" were classified under the main category "Individual → Group → Inheritance → Highly Abstract." Subcategories like "Totems are Endowed with Divinity," "Agricultural Activities," "Reverence for Heaven and Ancestors," "Rational Refinement of Cognition," "Yin-Yang Culture," "Unity of Heaven and Humanity," "Objectification of the Subjective World," "Frog Pattern," "Bird Pattern," "Interconnected Whirlpool Pattern," "Use of Red Pigment," "Environmental Harmony," "Progress in Production," "Improvement of Life," "Population Growth," "Improvement of Quality," "Bird Pattern," "Interconnected whirlpool pattern," "Z-shaped pattern," "Triangle Patterns," "Diamond Pattern," "Scalelike Patterns," "Continuous Two-sided Pattern," "Continuous Four-sided Pattern," "Wide-Band Pattern," "回-shaped patterns," "Hook-shaped pattern," "Don't Just Copy Patterns," "Integrating Patterns with Modern Aesthetics," "Breaking Taboos," "Extraction and Inheritance of 'Form,'" "Assimilation and Extension of 'Meaning,'" and "Attainment and Sublimation of 'Spirit,'" "Overall Reflection," "Design Beyond National and Cultural Boundaries," "Using Ancient Elements for Modern Transformation" were directly elevated to main categories.

Table 2
Axial Coding

Main Category	Sub-Category
Cultural significance	Production and daily life
	Reproductive worship
	Evidence of civilizational emergence
	Manifestation of the emergence of ritual system
	Embodiment of material culture
Totems are endowed with divinity	Totems are endowed with divinity
Symbolization → Centralization → Fixation → Sanctification	Symbolization
	Fixation
	Centralization
	Sanctification
Agricultural activities	Agricultural activities
"Reverence for heaven and ancestors"	"Reverence for heaven and ancestors"
Individual → Group → Inheritance → Highly Abstract	Individual
	Group
	Inheritance
	Highly abstract
The pattern system is an expression of the religious belief system	The pattern system is an expression of the religious belief system
Rational refinement of cognition	Rational refinement of cognition
"Yin-Yang culture"	"Yin-Yang culture"
"Unity of Heaven and Humanity"	"Unity of Heaven and Humanity"
The objectification of subjective world	The objectification of subjective world
Frog pattern	Frog pattern
Bird pattern	Bird pattern
Interconnected whirlpool pattern	Interconnected whirlpool pattern
The use of red pigment	The use of red pigment
Environmental Harmony	Environmental Harmony
Progress in Production	Progress in Production
Improvement of Life	Improvement of Life
Population growth	Population growth
Improvement of Quality	Improvement of Quality
Bird pattern	Bird pattern
Interconnected whirlpool pattern	Interconnected whirlpool pattern
"Z"shaped pattern	"Z"shaped pattern
Triangle pattern	Triangle pattern
Diamond pattern	Diamond pattern
Scalelike pattern	Scalelike pattern
Continuous two-sided pattern	Continuous two-sided pattern
Continuous four-sided pattern	Continuous four-sided pattern
Wide-band pattern	Wide-band pattern
"回"shaped pattern	"回"shaped pattern
Hook-shaped pattern	Hook-shaped pattern

Don't just copy patterns	Don't just copy patterns
Integrating patterns with modern aesthetics	Integrating patterns with modern aesthetics
Break taboos	Break taboos
Extraction and inheritance of "Form"	Extraction and inheritance of "Form"
Assimilation and extension of "Meaning"	Assimilation and extension of "Meaning"
Attainment and Sublimation of "Spirit"	Attainment and Sublimation of "Spirit"
Overall reflection	Overall reflection
Design beyond national and cultural boundaries	Design beyond national and cultural boundaries
Using ancient elements for modern transformation	Using ancient elements for modern transformation

3.3 Selective Coding

Compared to the axial coding, the concept extraction of selective coding emphasizes more abstract aspects, forming the core category of this study. In the selective coding phase, this research summarizes and integrates the 40 main categories formed by the axial coding, extracting more systematic core categories. Through the selective coding phase, seven core categories are finally formed. The main category "Cultural Significance" is directly used as a core category, with its sub-categories elevated to main categories. The sub-categories like "Totems are endowed with divinity," "Symbolization → Centralization → Fixation → Sanctification," are classified under the core category "Significance of Totem Worship." "Agricultural activities," "Reverence for heaven and ancestors," "Individual → Group → Inheritance → Highly Abstract," "The pattern system is an expression of the religious belief system," are categorized under the core category "Significance of Religious Beliefs." "Rational refinement of cognition," "Yin-Yang culture," "Unity of Heaven and Humanity," "The objectification of subjective world," are classified under the core category "Philosophical Significance." "Frog pattern," "Bird pattern," "Interconnected whirlpool pattern," "The use of red pigment," "Environmental Harmony," "Progress in production," "Improvement of life," "Population growth," "Improvement of Quality," are categorized under the core category "Auspicious Significance." Patterns like "Bird pattern," "Interconnected whirlpool pattern," "Z-shaped pattern," "Triangle pattern," "Diamond pattern," "Scalelike pattern," "Continuous two-sided pattern," "Continuous four-sided pattern," "Wide-band pattern," "回-shaped pattern," "Hook-shaped pattern," are classified under the core category "Significant Characteristics Patterns." "Don't just copy patterns," "Integrating patterns with modern aesthetics," "Break taboos," "Extraction and inheritance of 'Form'," "Assimilation and extension of 'Meaning'," "Attainment and sublimation of 'Spirit'," "Overall reflection," "Design beyond national and cultural boundaries," "Using ancient elements for modern transformation," are categorized under the core category "Cultural and Creative Design."

Table 3
Selective Coding

Core Category	Main Category
Cultural Significance	Cultural Significance
Significance of Totem Worship	Totems are endowed with divinity
	Symbolization → Centralization → Fixation → Sanctification
Significance of Religious Beliefs	Agricultural activities
	"Reverence for heaven and ancestors"
	Individual → Group → Inheritance → Highly Abstract
Philosophical Significance	The pattern system is an expression of the religious belief system
	Rational refinement of cognition
	"Yin-Yang culture"
Auspicious Significance	"Unity of Heaven and Humanity"
	The objectification of subjective world
	Frog pattern
	Bird pattern
	Interconnected whirlpool pattern
	The use of red pigment
	Environmental Harmony
	Progress in production
Improvement of life	
Significant Characteristics Patterns	Population growth
	Improvement of Quality
	Bird pattern
	Interconnected whirlpool pattern
	Z-shaped pattern
	Triangle pattern
	Diamond pattern
	Scalelike pattern
	Continuous two-sided pattern
	Continuous four-sided pattern
Wide-band pattern	
"回"shaped pattern	
Hook-shaped pattern	
Cultural and Creative Design	Don't just copy patterns
	Integrating patterns with modern aesthetics
	Break taboos
	Extraction and inheritance of "Form"
	Assimilation and extension of "Meaning"
	Attainment and sublimation of "Spirit"
	Overall reflection
	Design beyond national and cultural boundaries
Using ancient elements for modern transformation	

3.4 Coding Table and Theoretical Saturation Test

Through three-level coding of approximately three-fourths of the interview transcripts in this study, an encoding table was eventually established for the research theme "significance characteristics of the visual patterns on Hongshan culture," as detailed in Table 4. According to the requirements of Grounded Theory, to assess the credibility and sufficiency of the refinement of material concepts, main categories, and core categories, researchers need to conduct a theoretical saturation test. The theoretical saturation test entails the inability to discover new theoretical insights or examination categories from newly collected data. After determining the core categories, this study performed a theoretical saturation test using the remaining 1/4 of the data to validate the results generated by Grounded Theory. Through three stages of coding, the test results indicated a substantial repetition of concepts in the in-depth interview data. The encoding table for the research theme "significance characteristics of the visual patterns on Hongshan culture" remained applicable to new interview records. It can be considered that the encoding table proposed in this study for the research theme is theoretically saturated. Additionally, utilizing the visualization analysis features of NVivo 12 Plus software, tree diagrams were created for each of the seven themes and the overall node, as illustrated in Figure 1 to 8.

Table 4
The encoding table for the research theme "Significant Characteristics of Visual Patterns in Hongshan Culture"

Core Coding	Main Coding	Sub-Coding
Cultural Significance	Cultural Significance	Production and daily life
		Reproductive worship
		Evidence of civilizational emergence
		Manifestation of the emergence of ritual system
		Embodiment of material culture
Significance of Totem Worship	Totems are endowed with divinity	Totems are endowed with divinity
	Symbolization → Centralization → Fixation → Sanctification	Symbolization
		Fixation
		Centralization
		Sanctification
Significance of Religious Beliefs	Agricultural activities	Agricultural activities
	"Reverence for heaven and ancestors"	"Reverence for heaven and ancestors"
	Individual → Group → Inheritance → Highly Abstract	Individual
		Group
		Inheritance
	Highly abstract	
	The pattern system is an expression of the religious belief system	The pattern system is an expression of the religious belief system
Philosophical Significance	Rational refinement of cognition	Rational refinement of cognition
	"Yin-Yang culture"	"Yin-Yang culture"
	"Unity of Heaven and Humanity"	"Unity of Heaven and Humanity"
	The objectification of	The objectification of subjective world

	subjective world	
Auspicious Significance	Frog pattern	Frog pattern
	Bird pattern	Bird pattern
	Interconnected whirlpool pattern	Interconnected whirlpool pattern
	The use of red pigment	The use of red pigment
	Environmental Harmony	Environmental Harmony
	Progress in Production	Progress in Production
	Improvement of Life	Improvement of Life
	Population growth	Population growth
Significant Characteristics Patterns	Improvement of Quality	Improvement of Quality
	Bird pattern	Bird pattern
	Interconnected whirlpool pattern	Interconnected whirlpool pattern
	"Z"shaped pattern	"Z"shaped pattern
	Triangle pattern	Triangle pattern
	Diamond pattern	Diamond pattern
	Scalelike pattern	Scalelike pattern
	Continuous two-sided pattern	Continuous two-sided pattern
	Continuous four-sided pattern	Continuous four-sided pattern
	Wide-band pattern	Wide-band pattern
"回"shaped pattern	"回"shaped pattern	
Cultural and Creative Design	Hook-shaped pattern	Hook-shaped pattern
	Don't just copy patterns	Don't just copy patterns
	Integrating patterns with modern aesthetics	Integrating patterns with modern aesthetics
	Break taboos	Break taboos
	Extraction and inheritance of "Form"	Extraction and inheritance of "Form"
	Assimilation and extension of "Meaning"	Assimilation and extension of "Meaning"
	Attainment and Sublimation of "Spirit"	Attainment and Sublimation of "Spirit"
	Overall reflection	Overall reflection
Design beyond national and cultural boundaries	Design beyond national and cultural boundaries	
Using ancient elements for modern transformation	Using ancient elements for modern transformation	

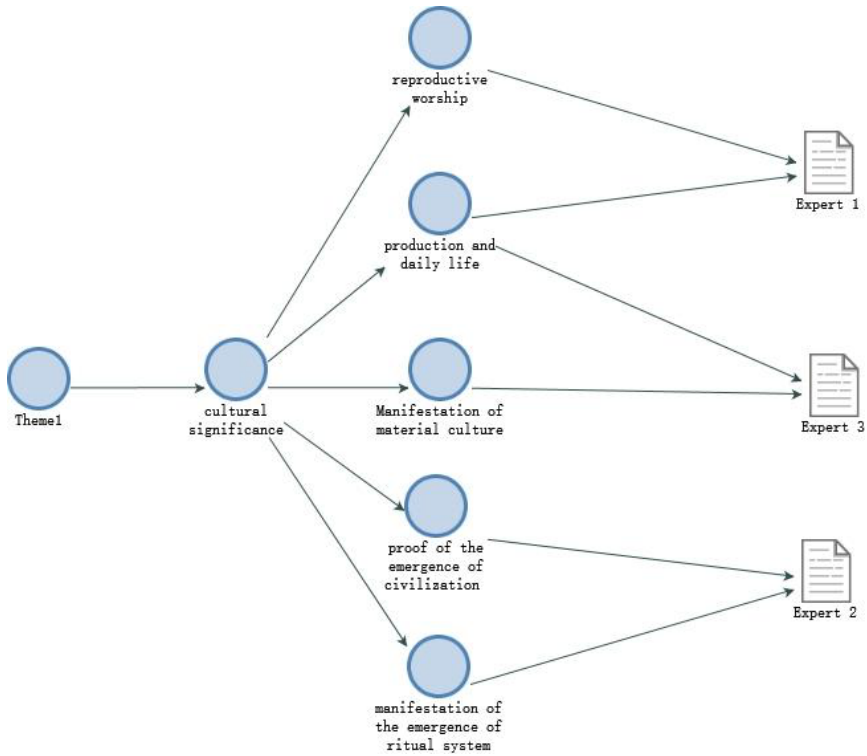


Figure 1. Visualization of Theme 1 Nodes

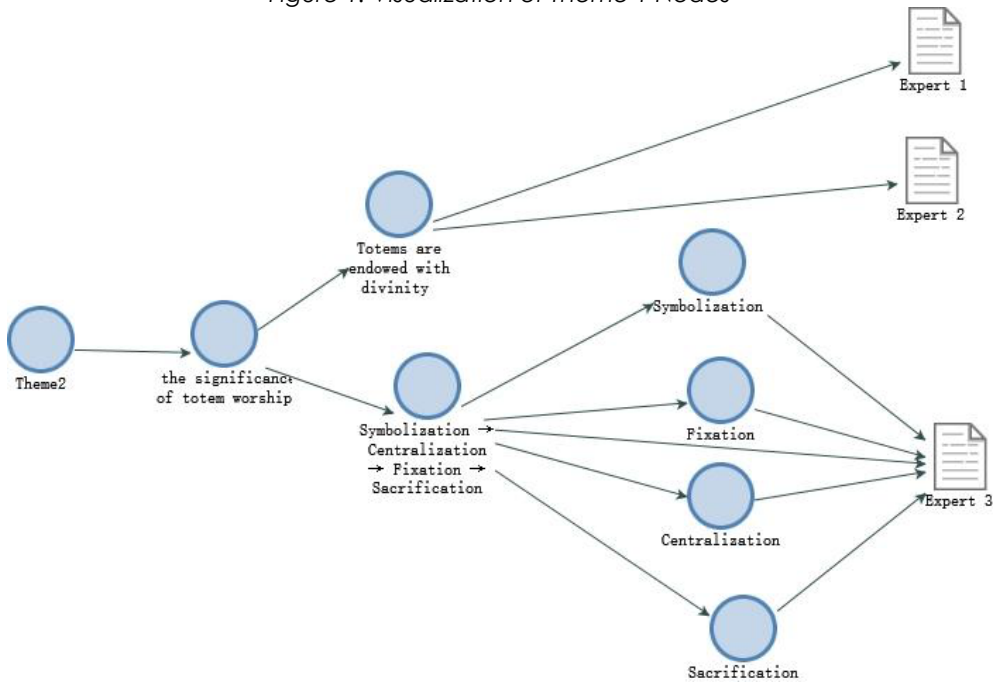


Figure 2. Visualization of Theme 2 Nodes

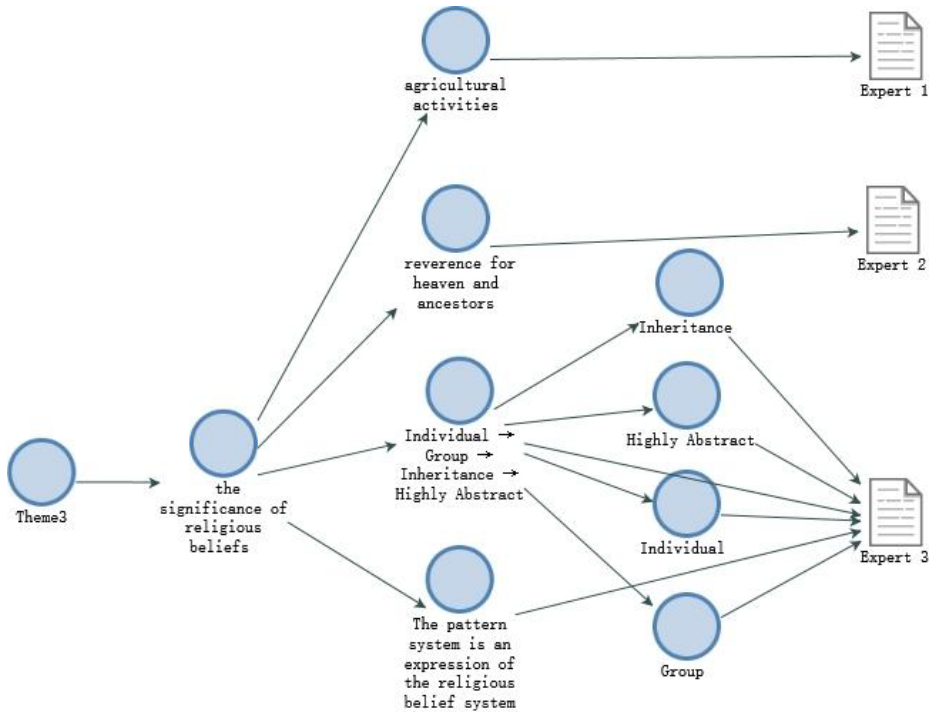


Figure 3. Visualization of Theme 3 Nodes

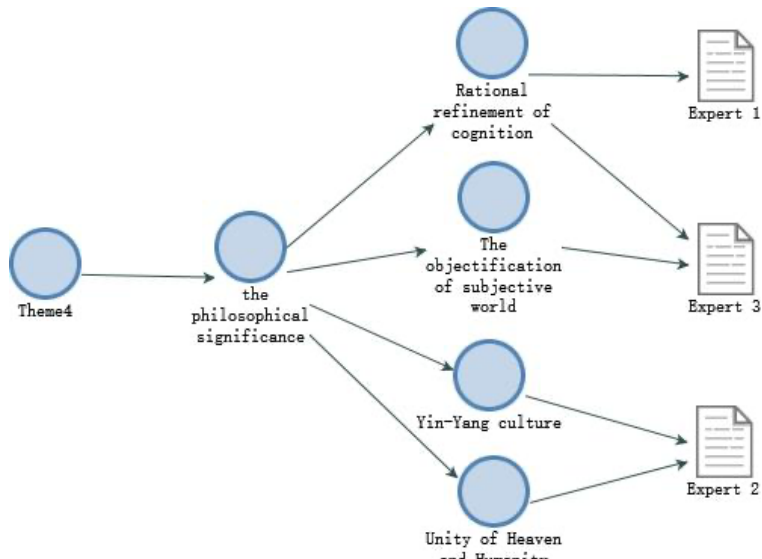


Figure 4. Visualization of Theme 4 Nodes

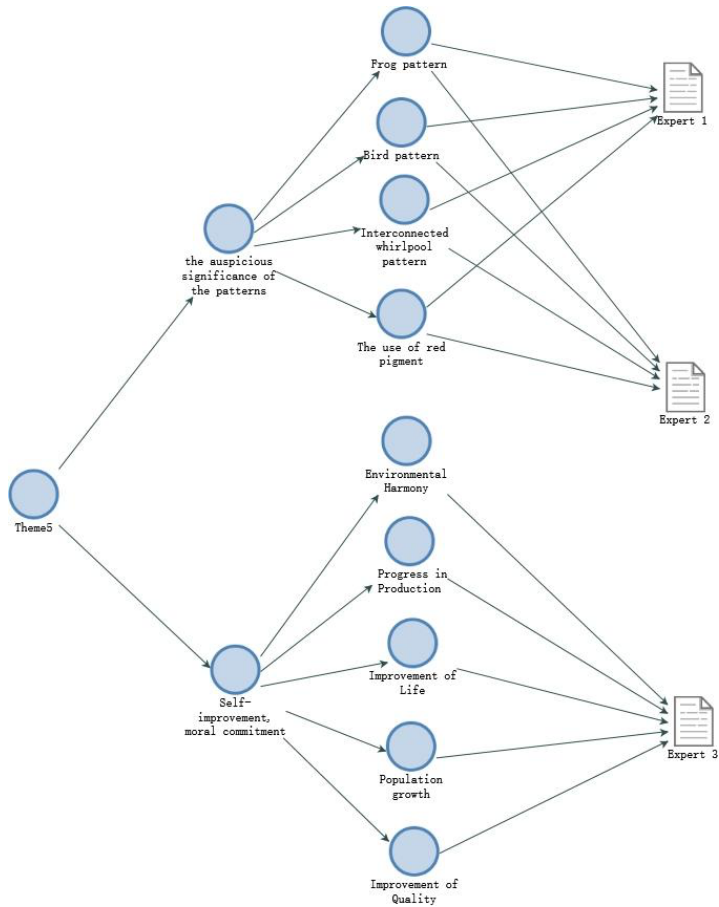


Figure 5. Visualization of Theme 5 Nodes



Figure 6. Visualization of Theme 6 Nodes

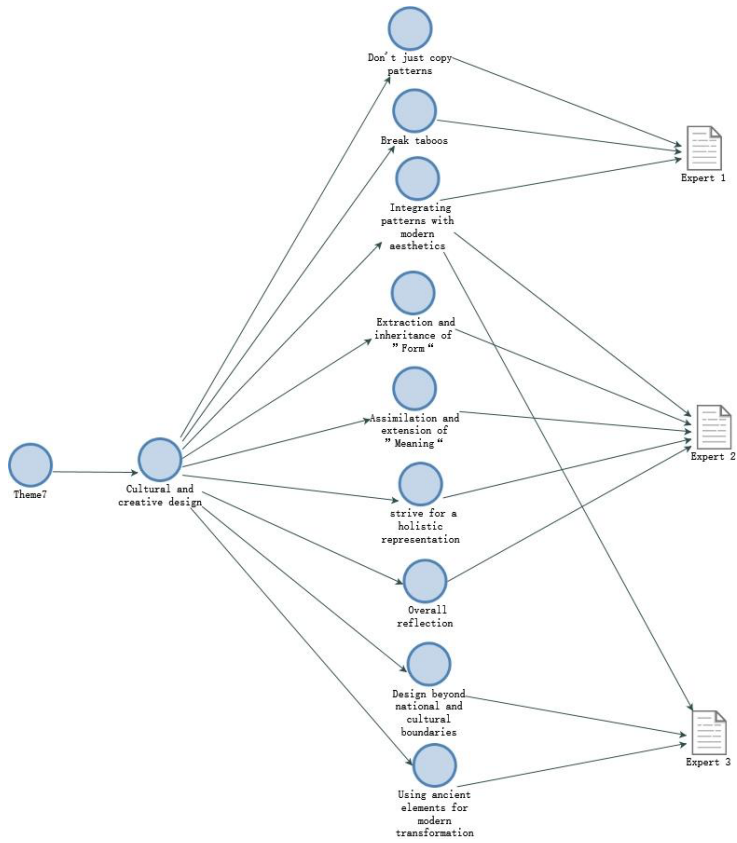


Figure 7. Visualization of Theme 7 Nodes

colors also stem from the early inhabitants' understanding of life; for example, the sun is red, and the night is black. The use of colors in pottery is also derived from daily life practices. Regarding the forms of patterns, in the Hongshan Culture, whether in pottery patterns, jade artifacts, or architectural layouts and designs, a sense of balanced symmetry is prominently displayed. Early inhabitants sketched many symmetrical, balanced, and consistently sized patterns on the three-dimensional surface of pottery, showcasing the beauty of balance and symmetry. This representation originates from life experiences.

Therefore, the cultural significance stems from practical life practices, forming a sense of form, color, and pattern in daily life. Pottery patterns reflect the initial aesthetic values of humanity, perfectly combining utility and aesthetics.

b) Expressing reproductive worship

Reproductive worship, as conveyed through the unique cultural connotations of pottery patterns in the Neolithic era, possesses a mysterious style. Engels explicitly stated in the preface to 'The Origin of the Family, Private Property and the State': 'Production has two sides. On the one hand, it is the production of the means of subsistence, i.e., food, clothing, shelter, and the necessary tools for this purpose; on the other hand, it is the production of human beings, the propagation of the species.' Due to harsh living conditions and scarce resources, primitive ancestors relied on their own reproductive production to continue their offspring, which became a significant factor restricting human historical development. Consequently, reproductive worship became the theme of primitive art.

The frog-pattern is one of the decorative patterns in Hongshan colored pottery. Hongshan ancestors used this pattern to express the frog's reproductive capability, symbolizing potent fertility. They depicted this pattern on the surface of pottery, reflecting the early people's psychological reverence for reproductive worship.

The characteristics of reproductive worship involve the belief in the mysterious reproductive power of nature and the veneration of sexual organs. Through rituals, magic, and fertility ceremonies, people sought to obtain vigorous reproductive spirits. In ancient times, primitive ancestors believed in a kind of magical faith that allowed for the mutual interaction and transmission of reproduction among humans, animals, or plants. By abstracting and imagining the images of certain animals or plants representing strong reproductive power on the surface of pottery, they could convey or control this reproductive power, ensuring the prosperity of the clan and the strength of the family.

c) Evidence of the Hongshan Culture Civilization

Hongshan Culture plays a crucial role and exerts significant influence in the overall origin of Chinese civilization; it is both a unified and diversified entity. Different cultures exhibit distinct characteristics in the use of pottery, and the decorative patterns on pottery hold great significance for the origin of Chinese civilization. From the perspective of civilization, it refers to the attainment of a certain level in various aspects of human material and spiritual development. The decorative patterns on Hongshan Culture pottery serve as tangible evidence of the representative origin of civilization, indicating that the state of civilization in Hongshan Culture has reached a certain level.

d) Manifestation of the Emergence of Ritual System

Throughout the course of historical development, pottery initially served practical purposes. As the early people gradually developed aesthetic awareness in their daily lives, patterns began to emerge on pottery. In later stages, pottery played a significant role in rituals,

and the patterns on pottery came to represent the subjective thoughts of the early people. Eventually, the ritual system emerged, becoming a crucial manifestation of civilization.

e) The embodiment of material culture

Hongshan Culture encompasses material culture, spiritual culture, and institutional culture. The patterns on pottery serve as a manifestation of material culture, presented in the form of patterns on the surface of pottery.

4.2 The significance of totem worship in the patterns on pottery of Hongshan Culture

a) Totems are endowed with divinity

The animal images, such as birds, deer, frogs, and dragons, in the patterns on Hongshan Culture pottery represent unique abilities and are showcased in the pottery patterns, endowed with divinity. Totem worship no longer revolves around the worship of the animals themselves but extends to the reverence for the meanings attributed to them by the ancestors, transcending the concrete worship of totems. Different societal modes of production and life can evoke distinct totemic worship practices.

b) Symbolization → Centralization → Fixation → Sanctification

A totem is a symbol. The collective consciousness of people, along with material culture, jointly forms a symbol, which constitutes a totem. Symbolization and centralization come together, giving rise to different totems based on various beliefs. Eventually, these totems converge into one or several totems, which then become fixed and established. The ancestors expressed totems through pottery, forming patterns that symbolized totemic worship. These patterns were sanctified through daily use and rituals, becoming objects of worship for the community. Therefore, analyzing the pottery patterns of the Hongshan Culture from the perspective of totem worship reveals a process involving symbolization, centralization, fixation, and sanctification. The pottery patterns reflect and embody the emergence, development, and evolution of totemic worship.

4.3 The significance of religious beliefs in the patterns on the pottery of the Hongshan Culture

a) Born out of agricultural activities

In the pottery patterns of the Hongshan Culture, the significance of religious beliefs not only needs to be combined with totem worship but also should be integrated with agricultural activities. In the Xinglongwa culture of the Hongshan Culture system, primitive agricultural activities had already emerged. By the time of the Hongshan Culture period within the Hongshan Culture system, agricultural activities had become quite mature. In agricultural societies, there was a great reverence for the 'Water God,' and elements related to agricultural activities such as the sky, clouds, and rain were highly valued. At this stage, the ancestors paid much more attention to nature and the environment than before. They would summarize some regular observations. Faced with many unexplainable phenomena, the ancestors would mythologize them, representing these elements with patterns on pottery surfaces. This allowed them to express their inner wishes through the depicted patterns. Consequently, based on agricultural activities, religious beliefs were born. Thus, agricultural production activities and religious beliefs are closely related, ultimately manifested in the form of patterns on pottery surfaces.

b) The patterns embody the concept of "reverence for heaven and ancestors"

In primitive society, the ideological foundation of "reverence for heaven and ancestors" was the spiritual strength of the early ancestors. In that spiritually omnipotent primitive society, religious beliefs have always been a powerful support and strong dependence for the early ancestors to survive. People placed all their hopes and wishes in religion. In this mindset and

psychology, the pottery patterns created by the Hongshan ancestors clearly bear immense religious devotion, embodying boundless hope. These works represent the continuation of their lives, the pillar of their spirits, and religious ideology dominates the creative thinking and thematic content of the people (Zhang Hongliang & Wu LAN, 2016).

c) Individual → Group → Inheritance → Highly Abstract

The entry point for understanding the significance of religious beliefs in the pottery patterns of the Hongshan Culture should be human consciousness, or, in other words, human faith. The process of its formation is the transformation of individual consciousness (individual religious beliefs) into collective religious beliefs, which is a significant leap. The collective religious beliefs, through inheritance, condense into a relatively precise and easily accepted system. From this perspective, the system of pottery patterns itself is a religious belief system, or, in other words, the pattern system reflects the religious belief system. The pattern system of the historical process of the Hongshan Culture undergoes evolution, with styles constantly changing. From the perspective of religious beliefs, it reflects the changes in the religious belief system. The pattern system is an expression of the religious belief system. It is a process from individual to group, group to inheritance, inheritance to refinement, forming essence, and highly abstracting into a core. Exploring and excavating the formation, development, and changes of the religious belief system of the Hongshan Culture can be done through the pattern system of the Hongshan Culture.

4.4 The philosophical significance of the patterns on the pottery of the Hongshan Culture

a) Rational refinement of cognition

The philosophical significance of the pottery patterns in the Hongshan Culture is the ancient people's understanding of the world and their knowledge of the heavens, earth, sun, moon, and all living things. The ancient people rationalized their cognition, forming conceptual meanings in a philosophical sense. Based on agricultural production and life, the ancient people's understanding of the world differs from the previous ancient cultures that were primarily nomadic. Therefore, they paid significant attention to the movements of the sun and moon, the changes in the four seasons, and how these changes affected their lives. Perceiving the various changes in nature during different seasons, the ancient people engaged in rational observation and summarization, reflecting philosophical meanings in their understanding of the world.

b) "Yin-Yang culture"

The philosophical dialectical thinking of traditional Yin-Yang culture is reflected in the pottery patterns of the Hongshan Culture. Day and night, cold and warmth, heaven and earth—all these were the most direct experiences of the ancient people. The red base with black embellishments, inverted patterns, and other elements in the patterns express the traditional Chinese philosophy of "Yin-Yang culture".

c) "Unity of Heaven and Humanity"

The concept of "Unity of Heaven and Humanity" represents an ancient cosmic worldview, and the Hongshan Culture serves as a significant origin of this philosophical idea. Pottery as a ritual instrument with social functions, became the most primitive and essential carrier for the Hongshan ancestors to revere nature and pursue a harmonious relationship between heaven and humanity. In the process of creating patterns, the ancient people expressed their aspirations for goodness by embodying them in the compositional elements of pottery patterns. The formed images are abstract and comprehensive, representing the unity of thought and expression, the product of collective wisdom and thinking. These are unique cultural and spiritual creations of the Hongshan ancestors, embodying the principle of "Unity of Heaven and Humanity".

d) The objectification of subjective world

The philosophical significance refers to in the relationship between the subjective and the objective, and the relationship between ideas and practices. In the context of the Hongshan Culture, pottery patterns embody the materialization of concepts. Philosophically, patterns are expressions and reflections of people's subjective consciousness, forming a set of patterns that reflect both their subjective consciousness and the objective world at that time. Therefore, through the pottery patterns of the Hongshan Culture, we can glimpse into the ideas of the ancient people and the objective world they faced. The philosophical significance of the Hongshan Culture's pottery patterns in the reflection of both the subjective and objective worlds, representing the objectification of subjective worlds and the materialization of concepts.

4.5 The auspicious significance of the patterns on the pottery of the Hongshan Culture

a) Auspicious meaning of the pattern

Throughout history and across different cultures, the understanding of auspicious meanings varies. Therefore, it is essential to carefully analyze the significance of patterns in both past and present societies. For instance, the frog pattern in the Xinglongwa culture symbolized abundance, and in today's society, frogs are still associated with prosperity. The bird pattern in the Zhaobaogou culture might be linked to the auspicious meaning of phoenix in contemporary understanding (Wang Qige, 2007). Similarly, the Interconnected whirlpool pattern, representing water, remains a symbol of good fortune in modern society. The use of red pigment in pottery patterns also reflects auspicious symbolism in the aesthetic preferences of contemporary Chinese society.

b) Continuously striving for self-improvement and carrying great virtue

The patterns of various cultures in the Hongshan region are all positive, reflecting the continuously striving for self-improvement and carrying great virtue. To elaborate, their auspicious meanings include the following aspects: First, the patterns reflect a harmonious environment, encompassing harmony among individuals and within society, achieving unity between heaven, earth, and humanity. Second, based on progress in production and life, the patterns reflect advancements in the quality of life; they are dynamic and changeable, mirroring the improvement in people's lives. Third, they demonstrate an enhancement in people's inherent qualities. In the early stages, patterns were simple and clumsy, while in later stages, they became fluent and magnificent, reflecting the improvement in people's qualities and perspectives. Therefore, the harmony of the environment, progress in production, improvement in living standards, population growth, and enhanced personal qualities all signify the auspicious nature of the Hongshan Culture pottery patterns.

4.6 Significant Characteristics Patterns

In the pottery patterns of the Hongshan Culture, the most typical designs include "Z" shaped pattern, Triangle pattern, Diamond pattern, Interconnected whirlpool pattern (floral pattern), Scalelike pattern, Wide-band pattern, "回" shaped pattern, Hook-shaped pattern, and Bird pattern. Hongshan culture pottery patterns of Continuous two-sided pattern, f Continuous four-sided pattern very characteristic.

4.7 Suggestions for the Application of Patterns in Cultural and Creative Product Design

a) Don't just copy patterns.

b) It is necessary to have a good extraction and design of the pattern, which must be combined with modern aesthetics.

c) Breaking the taboo of many modern people that many prehistoric artifacts are from tombs, delving into the meaning of the patterns themselves, and combining them with modern thinking can create cute or more acceptable designs for modern people.

d) Extraction and inheritance of "Form"

"Form" generally refers to the external shape and structure represented by a figure, here indicating the transformation of natural forms into a new aesthetic form through human processing. In modern art and design, the utilization of the 'form' of Hongshan Culture pottery patterns involves more than mere reproduction; it involves the extraction, recreation, and elevation of these patterns. This re-creation involves, firstly, a deep understanding of Hongshan Culture pottery patterns, applying their methods of composition involving points, lines, and surfaces to modern design. Secondly, it employs modern aesthetic perspectives to deform, combine, and iteratively apply the 'form' of Hongshan Culture pottery patterns to cultural and creative product design, expressing contemporary design concepts.

The "form" of Hongshan Culture pottery patterns exhibits abstract geometric characteristics, perfectly aligning with the rules of beauty in modern art and design. These forms can be applied individually or through various modern compositional forms, such as recombination, variation, and simplification. By abstracting and simplifying the 'form' of pottery patterns, conducting artistic refinement, and integrating with modern functionality and technology, the 'form' of Hongshan Culture pottery patterns can be extended and developed.

e) Assimilation and extension of "Meaning"

In modern art and design, inheriting the excellent traditions of pottery patterns and absorbing their cultural significance is a form of innovation. On one hand, it involves integrating the "meaning" of Hongshan Culture pottery patterns into the concepts of modern art and design. On the other hand, it combines this design philosophy with international advanced ideas and contemporary awareness, exploring creative thinking methods. The 'form' of pottery patterns carries symbolic meaning, with an indirect relationship between the abstract nature of symbols and their expressive significance, thereby providing space and depth for the absorption and extension of 'meaning' into "form."

The "form" of Hongshan Culture pottery patterns embodies the aspirations and longings of the ancient Hongshan people for beautiful things. In modern art and design, integrating the auspicious "meaning" of pottery pattern forms into advanced modern design concepts is a form of conceptual recreation. It combines and innovates the forms of pottery patterns with modern design, representing the absorption and extension of the "meaning" of pottery patterns. Building upon this inheritance, the structure of the "form" of Hongshan Culture pottery patterns is abstracted, decomposed, or reorganized, transforming it into symbolic forms with symbolic "meaning." These symbols are then applied to the design of cultural and creative products, extending the ancient "meaning" into the present day. In other words, the use of Hongshan Culture pottery patterns requires not only inheritance but also innovation. Building upon the original patterns, contemporary cultural spirit and epochal characteristics should be integrated. Using modern language, infuse its "meaning" into the design, merging the artistic aesthetics of ancient patterns with the contemporary aesthetic preferences of modern people.

f) Attainment and Sublimation of "Spirit"

If we consider the manifestation of "form" and "meaning" in Hongshan Culture pottery patterns in modern design as a surface-level extension and sublimation, delving deeper into the "spirit" of Hongshan Culture pottery patterns, transcending the materialized representation of traditional aesthetics, and exploring and seeking in the spiritual domain is an ongoing process of

innovation and sublimation based on the inheritance of the "form" and "meaning" of pottery patterns. It serves as the perpetual driving force for the development of Hongshan Culture pottery patterns in modern design.

In design, it is essential to creatively apply and develop pottery patterns, seamlessly integrating them with modern elements such as forms, concepts, and techniques. This fusion should give rise to works that possess a contemporary vibe and regional style. Shifting the "spirit" of Hongshan Culture pottery patterns allows them to transform into new artistic representations, incorporating modern technology to expand and elevate the expression of pottery patterns(Song Zhichun, 2019).

g) Do not limit yourself to one aspect, but to reflect the whole. Combining ancient symbols and elements with modern aesthetics.

h) Through research efforts, the design transcends countries and different cultures, is creative and novel, closely related to Hongshan culture, and combines traditional patterns with modern aesthetics.

i) Using ancient elements for modern transformation.

5. Conclusion

In people's daily lives, Hongshan Culture pottery patterns carry profound cultural connotations. Through analyzing their significance characteristics, it is evident that, after undergoing prolonged changes and development, traditional abstract patterns have deeply rooted themselves in ancient customs and culture. In the collision between tradition and modernity, traditional patterns have rejuvenated, providing valuable insights for the development of modern cultural and creative design (Yan Shuqin,2023) . This serves as a significant reference for the application of modern cultural and creative design, not just as an inheritance but also as an innovation where Hongshan Culture pottery patterns respond to the aesthetic preferences of a new era in novel forms. It is a commitment to stay true to our original aspirations, infusing traditional arts and aesthetic spirit into everyday life, and remembering the initial intentions of our modern cultural and creative design—to both preserve tradition and create the future.

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Authors Contributions

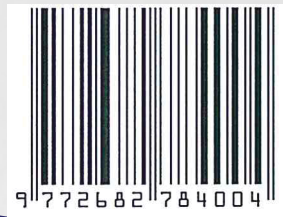
All authors have contributed to this publication through information, data findings, writing and editing contributions.

Conflict of Interest

The work described has not been submitted elsewhere for publication, in whole or in part, or is not under review process in another journal, and all the authors listed have approved the manuscript enclosed.

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