**UNIVERSITI TEKNOLOGI MARA**

# I-HATIC: A DIGITAL FRAMEWORK FOR INTERACTIVE TUTORING HANDWRITING ISLAMIC CALLIGRAPHY

**NURUSSABIHAH BINTI JAMALUDDIN**

**MSc**

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# I-HATIC: A DIGITAL FRAMEWORK FOR INTERACTIVE TUTORING HANDWRITING ISLAMIC CALLIGRAPHY

**NURUSSABIHAH BINTI JAMALUDDIN**

Thesis submitted in fulfilment
of the requirements for the degree of
**Master of Science**
**(Computer Science)**

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# CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 4 December 2025 to conduct the final examination of Nurussabihah binti Jamaluddin on her **Masters of Science (Computer Science)** thesis entitled "I-HATIC: A Digital Framework for Interactive Tutoring Handwriting Islamic Calligraphy" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiner recommends that the student be awarded the relevant degree. The Panel of Examiners was as follows:

Rizauddin Saian, PhD
Associate Professor
Faculty of Computer and Mathematical Sciences
Universiti Teknologi MARA
(Chairman)

Suriyani Ariffin, PhD
Associate Professor
Faculty of Computer and Mathematical Sciences
Universiti Teknologi MARA
(Internal Examiner)

Ibrahim Ahmad, PhD
Senior Lecturer
Faculty of Information and Communication Technology
Universiti Teknikal Malaysia (UTEM)
(External Examiner)

**PROFFESOR DR HJH ZURAEDA IBRAHIM**
Dean
Institute of Postgraduates Studies
Universiti Teknologi MARA

Date: 17 March 2026

# AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

| | |
|---|---|
| Name of Student | Nurussabihah binti Jamaluddin |
| Student ID. No. | 2020280878 |
| Programme | Master of Science (Computer Science) - CS750 |
| Faculty | Faculty of Computer and Mathematical Sciences |
| Thesis Title | I-HATIC: A Digital Framework for Interactive Tutoring Handwriting Islamic Calligraphy |
| Signature of Student | ^.,. „..... |
| Date | March 2026 |

# ABSTRACT

Nowadays, technologies are used in education to transmit information to all people. People can learn through the learning application, which contains education content that provides access from anywhere. Previous research also used electrical stimulation to help users write calligraphy and a tablet to record calligraphy traces to assess calligraphy fonts. It motivated the framework's limitations for interactive handwriting tutoring in Islamic calligraphy. The learner's exquisite fonts can be readily disrupted by electrical stimulation and users find it difficult to trace the letters of calligraphy. Therefore, this study proposed interactive tutoring in the handwriting Islamic calligraphy framework, namely the I-HATIC framework, as a guideline for designing and developing tutoring applications specifically for handwriting Islamic calligraphy. The tutoring application based on the proposed I-HATIC framework describes how human and computer interaction creates good calligraphy or style handwriting in interactive ways. It is motivated by the lack of a well-trained trainer teaching handwriting Islamic calligraphy and limitation of application to teach Islamic calligraphy. The methodology of this study involves four phases. Phase 1: Problem Investigation, which explores, defines, and understands the research problem through literature review and preliminary study. Next, phase 2: Framework Development, which involves content analysis and analysing the proposed components of the I-HATIC Framework. The initial draft of the I-HATIC Framework was validated by the expert review through face validation and content validation. The finalized and validated I-HATIC Framework has four components: Student Component, Tutoring Component, Expert Component, and Interactive Interface Component, with 28 criteria. Phase 3: Framework Evaluation involves an evaluation of a prototype demonstration, MobileCalliph: Learning Calligraphy for Beginners Application that implements a validated I-HATIC Framework. Next, the evaluation of the prototype shows a high level of interactivity, with an overall mean of 4.13 (82.68%) while participants were demonstrating the application. As a result, the proposed I-HATIC framework can be a guideline for producing up-and-coming handwriting Islamic calligraphy tutoring applications to attract more young generations to explore Islamic calligraphy and solve the problems of limited, well-trained trainers.

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# LIST OF SYMBOLS

**Symbols**

| | |
|---|---|
| N | The Total Number Of Experts |
| Ne | Number Of Experts Agreeing On A Rating Of 3 Or 4 |

# LIST OF ABBREVIATIONS

**Abbreviations**

| | |
|---|---|
| CVI | Content Validity |
| CVI | Principal Component Analysis |
| CVR | Content Validity Ratio |
| I-CVI | Item-Content Validity For Individual Items |
| I-HATIC | Interactive Tutoring Handwriting Islamic Calligraphy |
| ITHIC | Interactive Tutoring Handwriting Islamic Calligraphy |
| ITS | Intelligent Tutoring System |
| Pc | Probability Of Chance Agreement |
| S-CVI/Av | Scale Level Content Validity Index Based On The Average Method |

# CHAPTER 1
# INTRODUCTION

## 1.1 Background Study

Today, technology can be utilized in education to disseminate information to everyone. Students and teachers primarily use phones or tablets with internet access or applications for learning and teaching. They use learning applications to access information from anywhere easily. The rapid growth of technology give oppurtunities to teachers simply create teaching materials for instruction in class by using application that display educational multimedia which is including detailed text, voice and graphics (Lo & Tsai, 2022). Furthermore, users can improve their skills and behaviour through learning applications from passive to active, especially in Islamic calligraphy handwriting. Knowing the basics of Islamic calligraphy handwriting will attract people to learn and write Islamic calligraphy.

Islamic art calligraphy, known as "Khat," has been popular for generations worldwide. Khat is popular because of the beauty and uniqueness of the strokes in each letter, which symbolize how people write to communicate and show the beauty of letters in the Quran. After the evolution of the Quran, Islamic calligraphy is the script that appeared to write the Quran in noble and beautiful styles (Mohammed Alashari et al., 2020). Nowadays, people use Islamic calligraphy as an interior or exterior design painting aspect, especially in mosques and famous Islamic buildings. The Islamic calligraphy writing style is a source of inspiration and a starting point for communication (Mohammed Alashari et al., 2020).

Moreover, according to Ismail al-Faruqi describes Islam or the majlis that related to Islamic culture, Islamic calligraphy expressing the value of beauty and completeness of Quran and serves as the foundation for all Islamic law (Yunita, 2022). Islamic typography and Jawi script were inspired by Islamic calligraphy. Jawi script is used in the Malay community and has become their identity. Islamic calligraphy is now recognized as one of the writing skills that has advanced to this day and significantly aided in the global spread of Islam (Yunita, 2022). Today, most designer using Arabic typefaces to focus into creating readable, legible and eye-catching fonts to in designing

(Abu-Shaqra, 2020). Moreover, Islamic typography is used to type letters and text in graphic space and has become a branch of graphics (Safa & Abeddoust, 2020).

Despite the enormous success of technologies in education as learning applications, there is a way to explore and learn Islamic calligraphy handwriting. This art culture did not fully attract more people to learn. If people want to learn Islamic calligraphy handwriting, they must attend a class that makes it more time-consuming. Moreover, there has limited an application for Arabic calligraphy online instruction until 2021, Saudi Arabia's culture launched first online platform for teaching Islamic calligraphy (Aldayel & Saud University, 2024). Besides, during learning calligraphy, students got limited of quick feedback on student's writing performance when they out of the classes (Taele et al., 2020). Moreover, traditional calligraphy instruction, which is usually characterized by teacher demonstrations, student copying, and post-assignment correction, is becoming less and less adequate to fulfill the demands of contemporary learners (Mengqi. Wang, 2025).

Interactive tutoring for Islamic handwriting calligraphy applications describes how human and computer interaction creates good calligraphy or style handwriting in interactive ways. It is a standard application in education that can guide the creation of a style or calligraphy handwriting path for some new learners (Sarr et al., 2020). It is a concept like paper as a prototype and a computer as a teacher, using a guideline when students study how to create handwriting calligraphy properly. This method allows users to submit their handwriting and get feedback immediately and efficiently. As a new technology teaching method, this potential is motivated by the limited number of well-trained trainers who teach handwriting Islamic calligraphy (HIC). Moreover, in $20^{th}$ century, there were few textbooks that covered calligraphy writing rules and it was hard to find expert calligrapher or trainer (Nisyah et al., 2024). They are mostly teaching trainers who teach calligraphy from a teacher in school. It is hard for a trainer to train and guide a new learner to practice daily. These handwriting needs practice every day to make smooth and stylish handwriting.

Furthermore, tutoring system is computer based instructional system with models of instructional content that has specific content in teaching, and teaching strategies that give specify how to teach. It means that it can replicate individualized human tutoring inside a computing framework and serve as a cost-effective substitute for human tutors (Kochmar et al., 2022). It can excite and feel like learning with a trainer when a user plays this calligraphy handwriting application. Moreover, interactive

tutoring is capable of offering systematic help during problem-solving, monitoring pupils' skill and knowledge progression, and picking challenges according to individual needs (Kochmar et al., 2022).Users can play at the same time, and they can learn outside their class or academia. Furthermore, the trainer or coach does not have to worry about how they submit their task because this method can also submit their practice task to learn handwriting calligraphy. While learning, they can feel the beauty of Islamic calligraphy.

Lastly, this research is about producing a conceptual framework for interactive tutoring in handwriting Islamic calligraphy, especially the calligraphy type Nasakh. This research has been productive because of the problems people face in the current situation, such as a limited number of teaching trainers or teachers to teach Islamic handwriting calligraphy, a limited number of interactive features for students to practice or train calligraphy handwriting, and no established framework for interactive tutoring of Islamic calligraphy handwriting. The changes in teaching system were the problem that faced by students, such as inadequate facilities and trainers with limited teaching experiences (Fahmi, 2025). The study has manual guidelines for users to write calligraphy handwriting correctly in this framework. At the same time, users can feel the excitement of learning because it involves close interaction in suggesting, producing, modifying, and evaluating quick responses.

## 1.2 Problem Statement

Islamic calligraphy, characterized by its artistic intricacy and historical significance, has often been taught through traditional methods that may not fully engage learners or accommodate diverse learning needs. Current pedagogical approaches to teaching handwriting in Islamic calligraphy lack interactive frameworks that can facilitate more profound learning experiences and enhance student engagement. Research indicates that conventional tutoring styles often lean toward passive learning and do not capitalize on the educational benefits of active tutoring and interaction ((Hardman, 2015); (Ding et al., 2023)). Furthermore, increasing evidence suggests that learning is optimized when tutors and students participate in a dynamic, co-constructive relationship (Youde, 2019). They worry that Islamic calligraphy spiritual quality contrasts sharply with technology that they believe that abilities that require years of

training could be replaced with a single button (Sarbandi, 2021).

The need for a conceptual framework that emphasizes interactive tutoring becomes evident in Islamic calligraphy. Studies have shown that structured tutoring can bolster academic achievement and technical proficiency in skills such as calligraphy ((Hardman, 2015); (Kamarudin et al., 2020)). However, the unique modalities inherent to Islamic calligraphy, such as the multifaceted scripting style, necessitate a tailored approach that blends traditional skills with contemporary teaching methodologies. Effective interaction between tutors and students has been shown to correlate with enhanced student motivation and learning outcomes, particularly when the framework includes engaging, technology-enhanced tools ((Ding et al., 2023); ((Joubert & Snyman, 2020)(Enwereji et al., 2023)).

Moreover, Islamic calligraphy's cultural and artistic context provides a rich backdrop for interactive pedagogical methods. Integrating video-based learning and interactive platforms has significantly improved engagement in other disciplines (Ding et al., 2023); similar strategies could be effective for Islamic calligraphy. Given that motivation and enjoyment in learning correlate strongly with successful skill acquisition, developing a conceptual, interactive framework for tutoring in handwriting Islamic calligraphy is pertinent and necessary for nurturing appreciation and proficiency in this art form (Schodde et al., 2017).

The problem derives from the urgent need to develop a conceptual framework for interactive tutoring in handwriting Islamic calligraphy that efficiently integrates pedagogical strategies and cultural considerations identified in the existing literature. The proposed framework aims to foster a holistic learning environment that enhances learner engagement, pedagogical effectiveness, and skill mastery, thereby ensuring Islamic calligraphy's enduring relevance and practice in contemporary educational contexts.

Moreover, based on a preliminary study done through focus group sessions with experts in Islamic calligraphy, experts stated that the problem of a lack of a teacher or tutor to teach calligraphy always happens. There are many experts in writing Islamic calligraphy. However, they have not had much exposure to teaching the young generation because of a lack of practice and attendance in courses on teaching calligraphy. Moreover, the challenges faced by new students at P.P Wali Songo Sukajadi, such as disinterest in learning techniques, poor facilities, and a lack of direction because of inexperienced teachers (Fahmi, 2025). In addition, experts stated

that the student needs to attend the classes, prepare the writing tools, focus on the class and the practices by copying the calligraphy the tutor has written to improve their writing skills. They need to focus in class because the tutor will show them how to hold the pen correctly and write the letter precisely, so they can easily write beautiful calligraphy. Moreover, the student find it challenging to learn writing skills especially using pencils tools like brush or pen due to a limited of calligraphy instructor and supplies, while teachers find it difficult to express the precise details and rhythm of brushwork (Gong et al., 2025).

Moreover, experts reported that students must prepare their physical skills, writing tools and minds before attending the classes. The preparation is needed because they must focus on classes to master calligraphy writing skills easily and learn that calligraphy needs to be detailed. After all, through the letter, it can be seen that the beauty of calligraphy. The feeling of interest and passion also leads to success in handwriting Islamic calligraphy.

During the COVID-19 pandemic, tutor cannot teach their students face-to-face. They use existing technology, such as video conferencing, as an initiative to teach the students. Then, follow up by giving the exercise through social media tools, such as WhatsApp or Telegram. Online Arabic calligraphy learning provide the opportunity for every student to learn at their own pace and form any location. It can be seen in the following steps: a) preparation; (b) material explanation, which can take in form of videos, and images that posted in the Whatsapps groups; (c) questions and responses, (d) students compose and email their work to the instructor, (e) each student receive their feedback from the instructor via email (Muntaqim & Anshory, 2021). So, it needs more time to prepare before starting classes and the tutor will take time to give feedback.

Furthermore, one of the experts stated that the best method to get perfect calligraphy is to copy and paste. In the traditional method used to studying calligraphy writing, student observe how their writing differs visually from the static experts writing scripts (Fang, 2023). Furthermore, the tutor will give the sample to copy, and the student will copy the sample given to practice. This method lets students easily remember each letter's shape, size, and thickness. Besides, it can make the student more familiar with the character of each letter. Experts stated that students need to use this method to get excellent calligraphy because the size and thickness of each letter are important for beautiful calligraphy.

### 1.2.1 Research Gaps

Based on the problems discussed in the previous section, the following research gaps are extracted:

i. There is a limited framework for interactive handwriting tutoring in Islamic calligraphy.
ii. Using the traditional methods requires more time, discomfort, and difficulty in submitting the task than using an interactive tutoring system. Students believe that this community is exceptional since it provides an online option for learning Arabic calligraphy in a time when in-person instruction is not possible (Muntaqim & Anshory, 2021).
iii. Interactive tutoring needs to be an enjoyable environment.

Hence, based on these research gaps, there is a need for a comprehensive framework that clearly defines how to develop interactive tutoring applications for handwriting in Islamic calligraphy, especially for tablet applications, which provide the necessary implementation support to improve the enjoyable experience.

Therefore, this study proposes systematically developing a conceptual framework for interactive tutoring in handwriting Islamic calligraphy (I-HATIC Framework). The I-HATIC framework includes components for interactive tutoring applications. This study uses the current study to harness the identified interactive tutoring components successfully applied in handwriting Islamic calligraphy.

## 1.3 Research Question

According to the problem statements discussed above, this research intends to answer the following research questions (RQ):

**RQ1:** What are the key components for interactive handwriting tutoring in the Islamic calligraphy framework (I-HATIC framework)?

**RQ2**: How to develop a framework for interactive tutoring in handwriting Islamic

calligraphy (I-HATIC framework)?
RQ3: How is the proposed I-HATIC framework evaluated through tutoring the handwriting of the Islamic calligraphy application?

## 1.4 Research Objectives

This research's objectives are:

RO1: To identify key components for interactive handwriting tutoring in the Islamic calligraphy framework (I-HATIC framework).
RO2: To develop the interactive handwriting tutoring in the Islamic calligraphy framework (I-HATIC framework).
RO3: To evaluate the interactive of the tutoring handwriting Islamic calligraphy application that was developed based on the I-HATIC Framework.

## 1.5 Significance of the Study

This research aims to improve the interactive Tutoring Handwriting Islamic calligraphy conceptual framework to be more productive and exciting in learning the handwriting style. It is one way to attract people, especially the young generations, to learn more about calligraphy and enjoy it.

*Designer and Developer*

The framework can give designers and developers a vision for designing and developing an interactive Tutoring Handwriting Islamic calligraphy conceptual framework for handwriting application in Islamic calligraphy. Moreover, the designer can identify the existing framework's key usability issues and offer actionable insights for creating a more user-friendly and accessible design for users. At the same time, developers can optimize the performance and modular front-end framework, which can enhance coding efficiency and support seamless integration of design components in the application.

*User*

Like the young generation, a new learner can learn writing style, handwriting, and calligraphy in an interactive Islamic calligraphy handwriting application. It also makes a new learner more familiar with writing calligraphy, even if it is not in the proper way.

*Practitioner*

This framework can give some vision in learning and make it easier for a trainer to train new learners. They can get some vision through guidance to improve their learning outcome, and it can improve their writing skills by practising every day based on their performance (Sarr et al., 2020) Besides, the practitioner can get score feedback quickly and repeatedly retry to improve their writing skills (Sarr et al., 2020) It can upgrade the performance of student writing and give some enjoyment and excitement to learning. They will feel enjoyment through the letter they can choose to write or draw, leading them to do the task given (Sarr et al., 2020).

## 1.6 Research Scope and Limitations

The direction of the study is to develop a conceptual framework for interactive tutoring in handwriting Islamic calligraphy (I-HATIC) framework, which has some limitations for the research. Firstly, this study focuses on the interactive tutoring or I-HATIC framework for handwriting calligraphy learning. This framework only uses the interactive tutoring framework features to reduce accuracy errors and can give a learning environment with some guidance, like a teacher guiding students in the class.

Moreover, this study focuses only on Islamic calligraphy. Furthermore, it also contains the content of calligraphy history, calligraphy tools, two types of script, Islamic calligraphy, which are Naskh and Thuluth, and writing calligraphy letters. This setting can raise awareness among the young generation about Islamic calligraphy, and they can explore Islamic calligraphy handwriting further.

The component in the I-HATIC framework can be used in tablet or mobile applications. This is because it more compatible and more comfortable for the user to learn Islamic calligraphy handwriting applications. It is more spacious and users are

more attracted to learning through tablet applications.

Lastly, the scope of the study is directed more toward targeting users like the younger generations, from 10 to 12 years old. It is because it is easier for a young learner to learn from the beginning. Young learners are curious and enjoy exploring new things; this application is suitable for young learners to try and learn. Moreover, they are also more open to trying something new, even if it can benefit them. It seeks to advance knowledge of and encourage calligraphy among young Muslims by encouraging children's interaction with the art form and practical methods for boosting their enjoyment for it (Farhani et al., 2024).

## 1.7 Summary

This study research discovers the need to develop an interactive tutoring framework by considering the problems learners face when learning Islamic calligraphy traditionally. It also discovers interactive tutoring systems (ITS) components to make them more productive and enjoyable. Furthermore, this study's objective is also to develop the I-HATIC Framework. Developing this framework also limits research that needs to be considered: the total component needs, the focus content in this framework, and the target audience. Moreover, this study can give an advantage to the user who wants to learn about Islamic calligraphy handwriting. An Interactive Tutoring Handwriting Islamic Calligraphy conceptual framework (I-HATIC Framework) was also constructed to give some guidelines for producing a handwriting application, especially for applying Islamic calligraphy handwriting. The research framework also shows how to develop this framework for each phase. The user and handwriting trainer will test the validity of this research.

# CHAPTER 2
# LITERATURE REVIEW

## 2.1 Introduction

Islamic art calligraphy, known as "Khat," has been popular for generations worldwide. Khat is popular because of the beauty and uniqueness of the strokes in each letter, which symbolize how people write to communicate and show the beauty of letters in the Quran. After the evolution of the Quran, Islamic calligraphy is the script that appeared to write the Quran in noble and beautiful styles (Mohammed Alashari et al., 2020). Nowadays, people use Islamic calligraphy as an interior or exterior design painting aspect, especially in mosques and famous Islamic buildings. The Islamic calligraphy writing style is a source of inspiration and a starting point in communication (Mohammed Alashari et al., 2020).

A well-designed conceptual framework for interactive tutoring in handwriting Islamic calligraphy must build upon calligraphic instruction's cultural and pedagogical foundations and the technological advances in handwriting recognition and feedback systems. This literature review synthesises findings from studies on the significance of Islamic calligraphy in education, traditional pedagogical approaches, and emerging interactive technologies to identify design requirements and research gaps for such a framework.

## 2.2 Traditional Pedagogical Approaches to Calligraphy Learning

Qualitative analyses of calligraphy instruction in Islamic settings reveal a reliance on extracurricular clubs, studio-based mentorship, and pesantren (boarding school) traditions to transmit skills and values ((Hasanah & Harahap, 2024); (Madina, 2024); (Insani & Anam, 2023); (Wulandari & Sihombing, 2023). (Hasanah & Harahap, 2024) report that literature-driven curricula and expert-led demonstrations characterize calligraphy extracurricular activities in Islamic schools, yet often lack structured, learner-centred feedback mechanisms. Similarly, (Madina, 2024) observe that while

pesantren incorporate descriptive, literature-based methods to develop aesthetic appreciation, they offer limited opportunities for progressive skill assessment.

Studies of specialized studios, such as at Dar el-Khat Jember, note that in-person observation and guided practice remain the primary instructional modes but are constrained by tutor availability and subjective evaluation (Insani & Anam, 2023). (Wulandari & Sihombing, 2023) highlighted the lack of formalised pedagogical models to scaffold novices through incremental handwriting competencies. These findings indicate that traditional approaches emphasize socio-cultural immersion and mentorship but would benefit from systematic methodologies for skill progression and objective performance feedback.

The final research question is, *"How is the proposed I-HATIC Framework evaluated through tutoring handwriting Islamic calligraphy application?"*. To solve the research question, the initial draft of the I-HATIC Framework was distributed to experts with various backgrounds, academia and experience to validate and give feedback for improvement. Additionally, the prototype of the I-HATIC framework, the MobileCalliph application, was undergoing user evaluation to measure user engagement and enjoyment related to the I-HATIC Framework. During user evaluation, the participants were given the prototype, and the questionnaire was distributed to the participants to give feedback after testing the prototype based on the I-HATIC Framework. The final research objective was achieved due to these efforts: *"To evaluate interactivity of the I-HATIC Framework through tutoring handwriting Islamic calligraphy application.'*

## 2.3 Handwriting Islamic Calligraphy

Islamic calligraphy handwriting has become more well-known and popular through the generations. People love this handwriting because of its beautiful art and uniqueness. However, most people, especially the young generation, do not know how to preserve the beauty of this art for the next generation. Besides, people confuse Jawi, Islamic calligraphy handwriting and Islamic calligraphy typography. The calligraphy arrangements can be classified into several cultures: Eastern, Western, and Islamic Calligraphy (Turgut, 2014). Every country has different elements in its writing style. A letter is categorized as the main element in graphic design and communication. Each

letter can give an aesthetic form in art calligraphy. Especially in Arabic, there are different elements or ways of writing the calligraphy style to promote their identity by showing their art culture (Mohamed & Youssef, 2014). Islamic calligraphy presents aesthetic principles and a love for the Arabic language and culture through an aesthetic method of traditional Arabic art (Alashari et al., 2019).

Furthermore, Islamic calligraphy forms by conceiving ideas in abstraction, followed by belief in one god and rejecting materialization, which resembles notorious paganism (Peninsula et al., 2001). It means writing calligraphy shows an ideological image of expression, belief, power, and justification (Peninsula et al., 2001). It also shows the Islamic religion's beauty and the Quran's spiritual power (Schimmel & Rivolta, 1992). Moreover, Islamic art makes Arabic calligraphy a form of various kinds and inspires Muslim artists based on the Holy Quran (Teparic, 2014).

Islam also teaches us calligraphy based on the Holy Quran text to be incorporated into art culture and express our thoughts to show human existence in Arabic (Teparic, 2014). Every letter of Islamic Calligraphy has meaning and symbolism that give mysterious qualities and beautiful words (Teparic, 2014). During the seventh century, the most important factor that contributed to the enhancement of Arabic writing was the establishment of when establishing the Islamic religion, which delivered the first verse to the Prophet Muhammad S.A.W that contains an invitation to read, write and learn for all Muslims around the world to know more about Islam (Peninsula et al., 2001). This scenario is why transcribing the Al-Quran beautifully needs to persuade scribes to modify their handwriting to assume Islamic Calligraphy is Islam's most important art (Sahragard, 2016).

### 2.3.1 Type of Islamic Calligraphy

Islamic Calligraphy is a symbol of the beauty of Islamic handwriting and the identity of Islam. During the early period of Islamic calligraphy, two types of script were always used: the regular script and the Kufic script. The regular script is always used to write about people's daily life needs and a letter for a King and emperor of the Roman and Persian Kingdoms, while another script is the Kufic script used to write the Holy Quran (Alshahrani, 2008).

The two types of calligraphy that have been most popular in Arabic handwriting

from that period until now are Naskh and Kufic (Alshahrani, 2008)ritical mark (Alshahrani, 2008). Figure 2.1 below shows the Kufic script of Islamic calligraphy. The Kufic script is the origin of Arabic calligraphy. In the Naskh script style, a word is cursive scripted in a letter of a rounded shape, curved around each other to give a decorative dimension to the transliterated text (Alshahrani, 2008).

The evolution of the Arabic calligraphy script arose because two significant aspects lacked elegance and a standard of script regulation, with the aim of Arabic Calligraphy honouring the word of Allah, which needed reform (Alshahrani, 2008). After the revolution, some other scripts were successfully scripted by Ibn Muqlah, the Abbasid vizier and calligrapher, which are six cursive scripts: (a) Naskhi, (b) Thuluth, (c) Muhaqqaq, (d) Rayhani, (e) Riq'a, and (f) Tawqi. Table 2.1 shows the Kufic script of Islamic calligraphy (Ansari et al., 2024).

Table 2.1
Kufic Script Of Islamic Calligraphy

| | Uses | **Example** |
|---|---|---|
| £ | • Quran<br>• Architectural Deco<br>• Textiles<br>• Carpets | Jl^J.L^L |
| 3-a | • Quran<br>• Ceramics<br>• Metalwork | *wmmwi* |
| 3 14 © | • Quran<br>• Architectural Deco |  |
| If z | • Quran<br>• Architectural Deco |  |

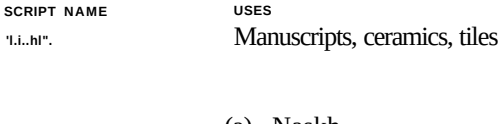
(Source: ((Ansari et al., 2024))

The most popular script that is still used now as decoration or writing is the Naskh script. Naskh script is derived from *"Nasakha,"* meaning to transcribe or copy, and it was developed during the 10th and 15th centuries by Seyh Hamdullah (Parvez, 2018). It becomes the most straightforward style of writing. The craftsman softens the edge of the style to make another style called Kufic, and if the shape becomes more detailed, thickened, stretched, prolonged, and overlapped, it is called Thuluth (Saberi et al., 2016). This script is designed to make it easier to read, which is why the Quran insists on clarifying that the alphabet employed needs to be clear enough for us to read (Saberi et al., 2016). The Quran used the Naskh script as a decoration for communication between Muslims and God (Saberi et al., 2016). Moreover, the Naskh script is always used for official and business documents and letters because it is a free-flowing technique and quicker to write (Parvez, 2018). This script style is diverse, easily copied, and can be learned quickly.

Riq'a is a cursive style and is the most commonly used handwriting in the Arab world. The Riq'a script was fully developed in the 11th century and established by Ibn al Khazin (Elshayyal, 2018). At the same time, Thuluth is an ornamental variety of Naskh. Its style is a rounded shape, linked and intersected, giving rise to a cursive flow of ample and complex proportion, as most elaborate graphics and outstanding plasticity (Elshayyal, 2018). Muhaqqaq has a less angular style than Kufic and has a well-spaced ligature. Ibn al Bawwab made the perfection style of Muhaqqaq by giving it shallow and sweeping horizontal sub-linear flourishes for impetus and a more extended upstroke for grandeur (Elshayyal, 2018). Its characteristics have become the favourite script for the large Quran in the Islamic East (Elshayyal, 2018).

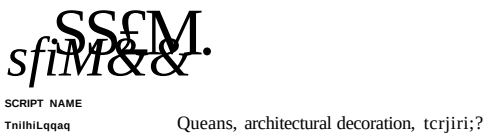
The Rayhani script was first developed during the 9th century and probably derived from Naskh and it has some characteristics in common with Naskh, Thuluth and Muhaqqaq (Elshayyal, 2018). Lastly, the Tawqi script was invented during the 9th century in the time of Caliph Al Ma'mun and the style is close to Thuluth, though its letters are more rounded (Elshayyal, 2018). Table 2.2 below shows an example of six cursive scripts for Islamic calligraphy.

Table 2.2
Example Of Six Cursive Scripts For Islamic Calligraphy

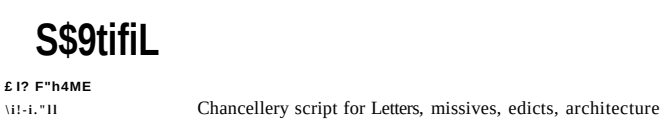



(a) Naskh

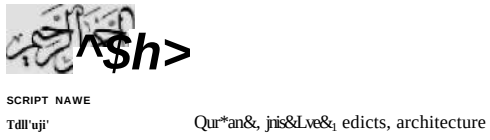

(b) Thuluth



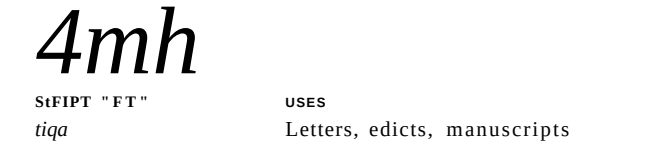

(c) Muhaqqaq




(d) Rayhani




(e) Tawqi




(f) Riqa'

(Source: (Sood & Fitzgerald, 2012))

There were other Islamic calligraphy scripts: Diwani, Ta'liq and Nasta'liq. The term *Ta 'liq*, which means *hanging*, describes the slightly curved lines that text flows through; this writing style creates the illusion of hanging (Ansari et al., 2024). The Ta'liq script was developed during the 10th century in Iran by Hasan ibn Husain Ali, the inventor of this writing script (Ansari et al., 2024). The script's primary features are its exaggerated horizontal strokes and rounded, curvy outlines, which were principally inspired by Riqa's writing style (Ansari et al., 2024). The Ta'liq script was generally used for royal everyday communication during the 14th century. After that, Nasta'liq was used as a writing communication (Ansari et al., 2024).

Moreover, the combination of Naskhi and Ta'liq script in the 14th century resulted in Nasta'liq (Alshahrani, 2008). Nasta'liq is a cursive writing style (Ansari et al., 2024). Furthermore, Nasta'liq is a variant style of Ta'liq. Mir Ali Sultan al Tabrizi developed it. The style for Nasta'liq is rounded curves and bold, clear lines, giving clarity and geometric purity that seems casual elegance (Elshayyal, 2018). Nasta'liq, regarded as the most advanced of the Iranian scripts, was frequently used in the Safavid dynasty's two-dimensional artwork (16th century) (Ansari et al., 2024). (c) The Ottomans invented the Diwani script, which was used for the official line during the Ottoman Empire (Alashari et al., 2019). Moreover, the style of the Diwani script was a curved line characterised as an easy-to-use, flexible, and soft line (Alashari et al., 2019). Diwani script and Nasta'liq script are shown in Table 2.3 below as examples of other script types in Islamic calligraphy.

Table 2.3
Example Of Another Script Of Islamic Calligraphy

| Type | Example |
|---|---|
| Not cursive script Diwani (Alshahrani, 2008) |  |

Not cursive script Ta'liq (Ansari et al., 2024)

The combination of Naskh and Ta'liq resulted in Nasta'liq (Alshahrani, 2008)


### 2.3.2 Islamic Calligraphy Handwriting, Typography, and Jawi

Muslims worldwide use Islamic calligraphy to write, read the Quran and learn about Islam. Most people know Islamic calligraphy, but it is confused with Jawi, Islamic calligraphy handwriting, and Islamic typography. Table 2.4 shows the difference between Islamic calligraphy handwriting, Islamic typography, and Jawi. Furthermore, Islamic calligraphy was inspired by Arabic script, while Jawi and Islamic typography were inspired by Islamic calligraphy to be used by all Muslims worldwide.

Table 2.4
Differences Between Islamic Calligraphy Handwriting, Typography, And Jawi.

| | Islamic calligraphy handwriting | Islamic typography | Jawi |
|---|---|---|---|
| **Origin** | It is practiced at a level of fine art. It must convert the verses of the Quran and the Prophet Muhammad's words into a visual masterpiece. | The Italian peninsula was the birthplace of European typography of the Arabic script, but it did not successfully spread everywhere except in the Netherlands and England. It became a study centre for Arabic and received constant attention worldwide (Kampman, 2011).<br>Typography is a branch of graphic design involving letters (Safa & Doost, 2017). | Derived from the Arabic alphabet and adapted for Malay language writing |
| **Year of introduction** | Islamic calligraphy was invented from the revelations given to the Prophet Muhammad between 610 and 632 and was first scribbled down on various materials, from bones to palm leaves.<br>After that, in the days of the third successor, caliph Uthman (664-56), the material was edited and completed into written copies of the Quran and sent to the different centres to expand the Islamic empire. | • The first time Arabic script was printed in the Netherlands was in 1595 by Franciscus Raphelengius when he published his Arabic-type specimen in Leiden (Kampman, 2011) | • It was introduced in Nusantara, and Islam was spread in early 674 by Muslims from China and Arab traders from the Middle East. |

| | | | |
|---|---|---|---|
| Total alphabet | An Islamic calligraphy, a beautifully written article using the Arabic alphabet | The Islamic typography alphabet is called Arabic script and contains 28 letters (Kampman, 2011). | It contains 35 letters of the alphabet and six letters from the original Arab alphabet. In contrast, the letter of *Hamza* is considered a diacritic in Arabic and Jawi as an introductory letter. |
| Style | Islamic calligraphy is written in an abstract or semi-abstract form, which usually has the meaning behind the writings and drawings of the verses, drawing and sometimes reveals the meaning of the sentence of the appearance painting. | Typography uses typed letters and text in graphic spaces (Safa & Doost, 2017). | Jawi handwritten characters are writer-dependent and show slope, stretch, skew, relative size, and letter appearance variations. Moreover, simplified writing of characters eliminates the basic features of the character. |

### 2.3.3 Significance of Islamic Calligraphy in Education

Islamic calligraphy has long been recognized as more than an aesthetic endeavour; it embodies core Islamic values and functions as a pedagogical medium for moral and spiritual formation. Lestari et al. emphasize that integrating calligraphy into Islamic education cultivates students' understanding of scripture and character through Shariah principles, reinforcing religious identity and ethical dispositions. Suharno & Mukhtarom, (2021) further identify that calligraphic practice carries intrinsic educational values, such as love for the Qur'an, diligence, patience, and optimism, which are essential for holistic student development and should be embedded within instructional curricula.

(Syarofah et al., 2022) note that calligraphy uniquely conveys aqidah (creed) and ubudiyah (worship) values through the visual articulation of sacred text, making it a powerful medium for transmitting both theological concepts and moral virtues. Similarly, Nasution & Harni, (2023) reported that calligraphy in Islamic educational contexts enhances students' technical writing skills while strengthening their internalization of moral values and devotional attitudes, supporting character education objectives. Beyond its value-laden content, calligraphy is an experiential learning activity that enriches cultural literacy and personal growth.

(Huda et al., 2024) showed that calligraphy and other extracurricular pursuits contribute to students' cultural and religious understanding while fostering fine motor skills and self-expression, thus playing a complementary role in character education within pesantren settings. Hasanah & Harahap, (2024) analysis of calligraphy extracurricular programs in Islamic institutions reveals that structured practice sessions deepen students' mastery of Arabic script and encourage creative engagement with Qur'anic verses, aligning technical proficiency with spiritual reflection. Extend these insights by illustrating how calligraphy is used as a decoration and a medium for disseminating da'wah messages, sustaining communal engagement with Islamic heritage and reinforcing the art's pedagogical impact beyond the classroom (Madina, 2024). These studies demonstrate that Islamic calligraphy is an instructional vehicle for transmitting religious values and a transformative practice that bolsters students' moral, cognitive, and cultural competencies.

## 2.4 Interactive Technologies for Handwriting Calligraphy Tutoring

Integrating interactive technologies into calligraphy education significantly advances instructional methodologies, promoting engagement and enhancing learning outcomes. Traditional calligraphy education often relies on instructor-led demonstrations and manual practice; however, technological innovations such as multimedia platforms, computer-aided design tools, and interactive systems are transforming these practices by providing dynamic and personalized learning experiences.

One of the foundational aspects of implementing interactive technologies in calligraphy education involves the construction of comprehensive teaching platforms that incorporate multimedia and streaming capabilities. Chen's exploration of an interactive teaching platform for calligraphy within higher education emphasises the importance of enhancing student engagement through multimedia resources and feedback mechanisms (Zeng, 2023). The platform facilitates file uploads and evaluation systems and employs a fuzzy comprehensive evaluation model that quantitatively measures learning outcomes, illustrating a structured approach to assessing student performance in calligraphy. Such platforms address the limitations of traditional methods, enhancing participatory learning and fostering a collaborative environment among students.

A more specialized interactive system, as developed by Wang and Chen, incorporates affective computing and visualization techniques for real-time analysis of students' emotional states during their calligraphy practice (Wang & Chen, 2020). This innovative method allows students to receive immediate feedback on technical aspects of script creation and the emotional engagement associated with their practice. By employing haptic interface devices, this system facilitates a sensory experience that engages learners differently from traditional methodologies, enhancing their artistic expression and learning efficacy.

Furthermore, the design of computer-aided technologies remains a pivotal element in modern calligraphic education. For instance, Li's research on electronic creation software for calligraphy emphasizes the necessity for artists to possess both technical proficiency and a solid understanding of artistic principles (Li, 2023)). This software framework aids in preserving traditional calligraphic styles while allowing for

the digital replication and innovation of these art forms, effectively bridging the gap between ancient practices and contemporary artistry. Interactive software not only aids in skill mastery but also accommodates diverse learning paces and styles, thus catering to a broader audience from novices to advanced practitioners.

Despite these advancements, challenges remain in effectively integrating traditional calligraphy techniques with contemporary technology. Fawzani et al. underline the importance of navigating aesthetic considerations inherent to Islamic calligraphy when developing educational technologies, ensuring that the cultural integrity of the art form is maintained (Fawaid & Sultoni, 2022). Technologies must not only serve educational purposes but also respect and reflect upon calligraphy's historical and cultural significance as a fundamental aspect of Islamic art.

Moreover, engaging interactive tools can promote a deeper understanding of calligraphy as both a technique and an art form. This setting is critical in educational settings where the aesthetic values of calligraphy can enhance students' appreciation of cultural heritage. Teacher-led interactive sessions and digital platforms can offer comprehensive learning experiences that balance traditional craftsmanship with modern creativity ((Huang & Qiao, 2024), (Lin et al., 2023)).

In conclusion, interactive technologies in handwriting calligraphy tutoring are poised to revolutionize educational practices, fostering deeper engagement, creativity, and cognitive development among learners. Educators can elevate traditional calligraphic instruction by integrating multimedia platforms, emotional feedback systems, and computer-assisted design tools, ensuring its relevance in contemporary education while preserving its rich historical essence.

## 2.5 Relevant Theoretical Fundamentals for Interactive Tutoring Systems

This study reviewed and analysed six relevant, interactive tutoring systems (TS), each offering insights to develop an interactive tutoring framework tailored for handwriting Islamic calligraphy (I-HATIC).

### 2.5.1 Djehuty Intelligent Tutoring System (ITS)

A Djehuty ITS has a module that generates a handwriting style and suggests handwriting paths to the child in a mixed-initiative manner (Sarr et al., 2020). Djehuty incorporates gamification features such as simplicity, feedback, real-time response and ITS components such as interactivity, expert model, student model, generativity, and mixed-initiative (Sarr et al., 2020). It makes it more enjoyable and friendly, which makes the user want to retry to improve their handwriting skills.

Moreover, Djehuty ITS introduces a novel mixed-initiative loop wherein the learner initiates the task by selecting a letter, and the Al responds with variations generated through a sketch-RNN model. Figure 2.1 embodies iterative refinement, where a successful learner attempts to inform subsequent Al-generated tasks. Specifically, if a learner scores 3.5 stars or higher, the Al model adapts future outputs to match the learner's style, a technique that personalizes instruction without sacrificing instructional goals.

In addition, Djehuty ITS aligns with and extends earlier work in handwriting instruction across various scripts (e.g., Latin, Arabic, Bengali, Kanji). Previous systems primarily focused on expert modelling and corrective feedback; however, Djehuty stands out through its mixed-initiative interaction, where both the learner and Al contribute to task refinement. The system adapts letter shapes based on learner performance, maintaining a creative and exploratory environment while ensuring progression toward standard forms. Its gamification elements, such as real-time scoring and retry loops, further enhance engagement and align well with early childhood learning theories, emphasising motivation, repetition, and exploration.

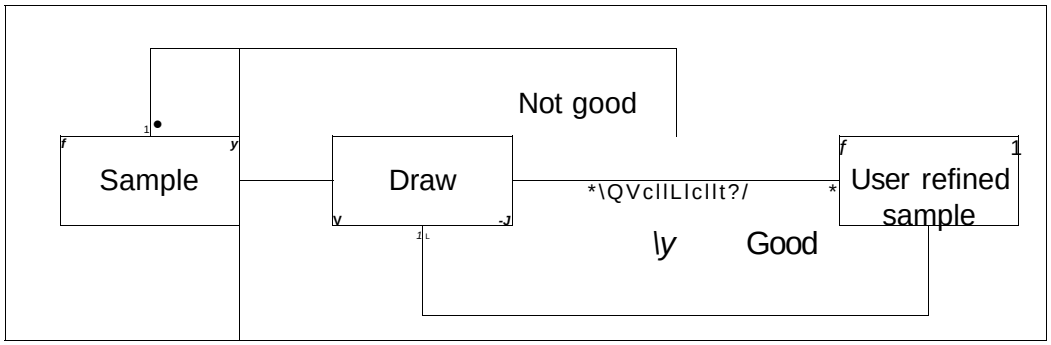



Figure 2.1 The Iterative Refinement, Where A Successful Learner Attempts To Inform Subsequent AI-Generated Tasks

### 2.5.2 Handwriting-based Intelligent Tutoring Systems (ITS)

A handwriting-based ITS paradigm uses student modelling features by collecting learner performance, accepting handwriting input from a learner, and solving the problem by reducing recognition errors (Anthony et al., 2012). This ITS explored the affordances of handwriting and pen-based input in intelligent tutoring systems for mathematics, specifically algebra equation solving (Anthony et al., 2012).

Moreover, this ITS supports handwriting input and highlights several pedagogical advantages of pen-based interfaces, including improved problem-solving fluency, reduced cognitive load, and better transfer of learning to non-digital contexts than keyboard or speech input. Figure 2.2 shows the complete tutoring cycle for a handwriting-based Intelligent Tutoring System (ITS). It details how a student progresses from learning a new problem type through worked examples, solving problems via handwriting, and receiving immediate feedback based on their typed final answer.

If the answer is incorrect, the system initiates a recognition phase using stroke analysis and context to identify the first error step. The student then confirms or clarifies the tutor's hypothesis, possibly typing a specific step. Feedback is given to guide corrections, and the process repeats until the correct answer is provided. Upon mastery, the tutor advances the student to new problem types, ensuring a seamless integration of handwriting input and adaptive learning support.

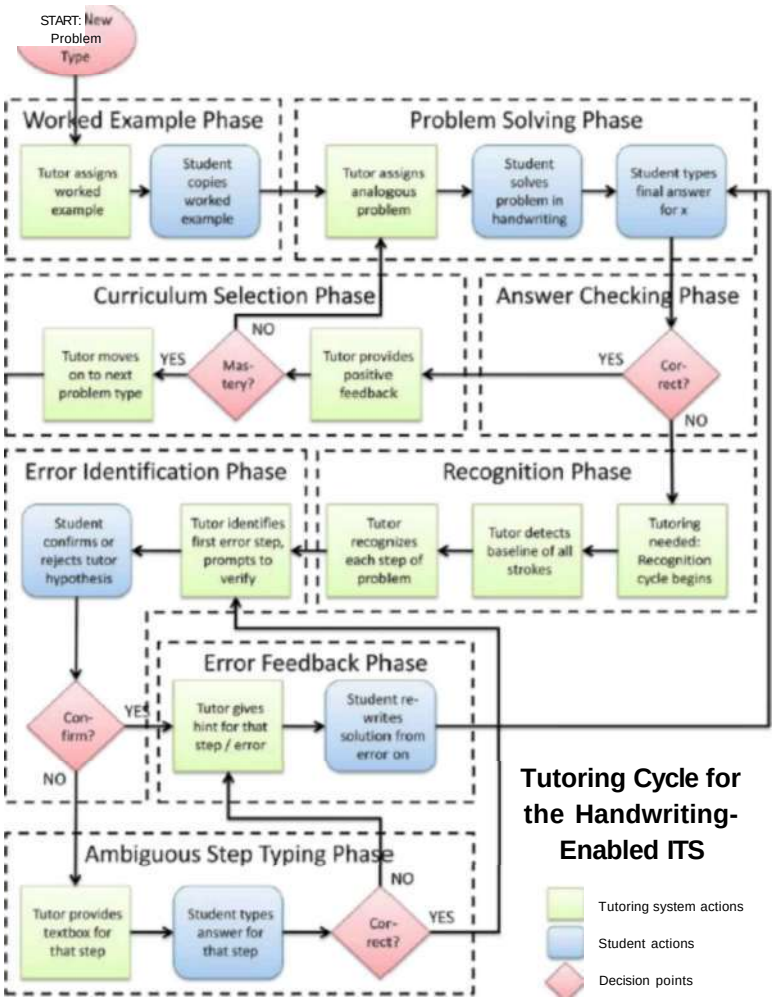



Figure 2.2 The Complete Tutoring Cycle For A Handwriting-Based ITS

### 2.5.3 D'Nelian Handwriting System

D'Nelian Handwriting System provides feedback on children's work, gives feedback on what they did right or wrong, and instructs how to correct what they made (Maxim et al., 2007). Besides, it also used three modules of the ITS to develop system design, which are (1) a student writing and feedback module, (2) an interactive gaming environment where students play an in-game environment to find the hidden treasure, and (3) a teacher evaluation and feedback module (Maxim et al., 2007). Learning via gaming goals is to create an immersive gaming environment using a tablet PC and teach students how to write using the D'Nelian Handwriting System.

(Maxim et al., 2007) explore the development of an immersive learning environment to teach elementary school children handwriting using a serious game format.

The authors designed an educational game delivered via Tablet PCs, which allows children to write directly on the screen with a stylus. The game incorporates intelligent tutoring systems (ITS) to offer personalized feedback and adaptive instruction, responding to each student's performance to guide their learning process. The system is designed to teach the D'Nealian handwriting system, with in-game mechanics that reward correct writing by unlocking new content and challenges. Figure 2.3 shows the architecture of the D'Nelian Handwriting System.

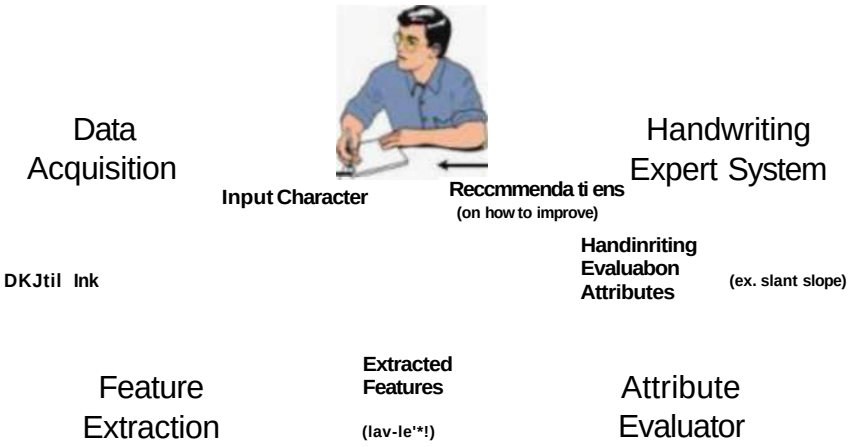



Figure 2.3 The Architecture Of The D'Nelian Handwriting System

### 2.5.4 Writing Pal (W-Pal) System

Another study related to a tutoring system is the Writing Pal (W-Pal) Intelligent Tutoring System (Roscoe et al., 2014). W-Pal is an automated writing evaluation (AWE) tool that supports and enhances writing instruction. Developed through interdisciplinary collaboration, W-Pal incorporates cognitive and computational linguistic theories to guide learners through the writing process. The system includes instructional lessons, game-based practice modules, and essay-writing opportunities paired with formative feedback. Unlike traditional AWE systems focusing primarily on grammar and mechanics, W-Pal emphasises deeper writing constructs such as cohesion, lexical sophistication, and syntactic variety, aiming to foster improved writing quality through cognitive engagement.

W-Pal utilises natural language processing (NLP) to assess various linguistic features correlating with writing proficiency. These assessments inform the feedback

provided to students, which is tailored to guide revision and reinforce writing strategies taught in the lessons. The system's efficacy is supported by empirical findings, which demonstrate significant improvements in students' writing performance, particularly among struggling writers. The paper underscores the importance of aligning AWE systems with pedagogical goals and cognitive theories to ensure meaningful writing instruction rather than relying solely on surface-level corrections.

### 2.5.5 Gamification in Intelligent Tutoring Systems

The study (González & Mora, 2014) explores integrating gamification elements into ITS to enhance student motivation and engagement, especially in mobile and ubiquitous learning environments. The authors note that while it has shown promise in improving learning outcomes, its usage is hindered by monotony and lack of motivation among students. To address this, the paper proposes incorporating gamification strategies, typically effective in engaging users through game-like experiences, into ITS, transforming traditional tutoring into a more stimulating and interactive experience. Drawing on established ITS architecture (Pedagogical Module, Expert Module, Student Module and Tutoring Process Module), the authors suggest adding a dedicated gamification module to make learning more appealing and effective. Figure 2.4 shows the conceptual model proposal for gamification in ITS.

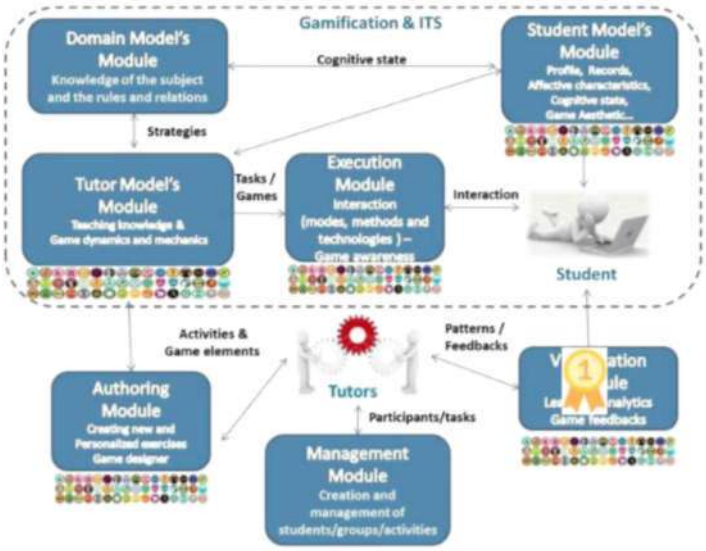



Figure 2.4 The Conceptual Model Proposal For Gamification In ITS

### 2.5.6 Sketchtivity System

(Williford et al., 2020) explored the development and evaluation of an Intelligent Tutoring System (ITS) called Mechanix, designed to support students in learning sketching fundamentals. The system focuses on freehand engineering sketching, one of the critical skills in engineering education, by providing real-time feedback and interactive guidance. The study highlights how sketching, while foundational, is often neglected in modern curricula due to limited instructor time and large class sizes. Mechanix addresses this gap by automatically evaluating sketches and delivering formative feedback on proportion, alignment, and shape accuracy using a digital pen-based interface. It contains the Intelligent Tutoring System component, Student Model, Expert Model and Interactive gaming environment (Williford et al., 2020).

This study conducted a user study involving undergraduate engineering students to assess the effectiveness of Mechanix. Findings showed that students who used the ITS significantly improved their sketching skills over time, compared to those who did not receive feedback or only used conventional tools. Participants appreciated the system's ability to provide immediate, personalized feedback and reported increased motivation and engagement. The feedback mechanism was based on analyzing both stroke-level and object-level characteristics of sketches, helping learners refine their understanding and execution of sketching principles.

All six relevant, interactive tutoring systems (TS) identified and analysed were summarized in Table 2.5.

Table 2.5
Review Of Relevant Theoretical Fundamentals

| | Descriptions | References |
|---|---|---|
| Djehuty Intelligent Tutoring System (ITS) | • Djehuty ITS for Preschoolers is equipped with an AI module, which generates a handwriting style and suggests handwriting paths to the child in a mixed-initiative manner.<br>• Djehuty ITS incorporates gamification features such as simplicity, feedback, and real-time response and ITS components such as interactivity, expert model, student model, generativity, and mixed-initiative. | (Sarretal., 2020) |
| Handwriting-based Intelligent Tutoring Systems (ITS) | • Handwriting-based ITS explored the affordances of handwriting and pen-based input in intelligent tutoring systems for mathematics, specifically algebra equation-solving. | (Anthony, Koedinger, Yang, 2012) |
| D'Nealian handwriting system | • Learning via gaming aims to create an immersive gaming environment using a tablet PC and teach students how to write using the D'Nealian handwriting system.<br>• This article uses an ITS to provide feedback on children's work, guide them on whether they did right or wrong, and show them how to correct the errors.<br>• It also has a system designed for an interactive gaming environment. | (Maxim et al., 2007) |
| Writing Pal (W-Pal) System | • ITS uses an innovative blend of explicit strategy instruction, game-based practice, essay writing practice, and automated formative feedback to increase students' writing skills. | (Roscoe et al., 2014) |
| Gamification in Intelligent Tutoring Systems | • The ITS was built to solve the problem and help the students learn Computer Science.<br>• It contains the components of an intelligent tutoring system: a pedagogical module, an expert module, a student module, and a tutoring process module. | (Gonzalez & Mora, 2014) |
| Sketchtivity System | Each lesson allows the user to practice eight samples of the supplied design and provides feedback on the sketch's correctness, line quality (smoothness), and speed.<br>The sketchtivity system was designed not to replace human instructors but to enhance the educational experience of learning to draw with technology. | (Williford et al., 2020) |

## 2.6 Interactive Tutoring Handwriting Islamic Calligraphy Conceptual Framework (I-HATIC Framework)

The Interactive Tutoring in Handwriting Islamic Calligraphy (I-HATIC framework) is a conceptual model designed to guide the development of digital learning environments that integrate traditional Naskh and Thuluth script pedagogy with modern interactive technologies. It aims to support learners across various age groups, especially ages 10 to 12, through interactive handwriting experiences using digital tools such as stylus-enabled tablets. Rooted in established relevant theoretical fundamental theories, I-HATIC emphasises the balance between technology, pedagogy, and user experience. By embedding feedback, motivation, and usability principles, the framework addresses the challenges of digitizing Islamic calligraphy instruction while preserving its cultural authenticity and aesthetic discipline. The core components of the I-HATIC Framework are:

### 2.6.1 Student Component

The student component is like an agent for the user. It contains the user's details, such as their knowledge, learning style and actions (Noh et al., 2012). It also evaluates the angular distance between the student trial and the sample to measure performance (Sarr et al., 2020). Furthermore, the student model is in charge of generating the student's knowledge state (González & Mora, 2014)). This module compiles the pupils' basic information about their behaviour, mental characteristics, and learning progress (M. A. Hasan et al., 2020).

Moreover, the student knowledge represented in this model is related to the topics (concepts, facts, procedures, rules and skills), misconceptions (well-understood error, bug library), skills (learning style, preference, habits and concentration), student experience (history, student attitude and task experience), affective skills (challenge engagement and seriousness) and stereotypes (general knowledge of student) (González & Mora, 2014). While, according to Morgan et al., 2020 the student component in ITS's representation of the student's cognitive abilities, including knowledge, affect, motivation, and other psychological traits, is known also as the learner model.

### 2.6.2 Expert Component

The expert component agent chooses the user's tutoring strategy (González & Mora, 2014). In Djehuty's article, expert modelling is used to evaluate the students and the system to compare the line order produced with the reference (Sarr et al., 2020). Moreover, it can be employed to evaluate the pupil's overall development (Muangprathub et al., 2020). It also provides feedback on each sketch's accuracy, line quality and speed (Alrakhawi et al., 2023; Williford et al., 2020). Moreover, the expert model provides a benchmark for expert performance for the learners to gauge their progress (Alrakhawi et al., 2023).

### 2.6.3 Tutoring Component

The tutoring component provides users with step-by-step feedback to help them work (Anthony et al., 2012). Furthermore, it is based on the interaction between the domain and student models to provide the most appropriate pedagogical strategies and actions for a particular student (e.g., giving a hint in response to a wrong answer or assigning particular problems that target the skills that the student needs to improve upon) (Banawan et al., 2023). In addition, the tutoring component is the central component of the ITS and implements the tutoring strategy (Paladines & Ramírez, 2020).

Moreover, it may consist of the following elements: a) objects (explanation, examples, hints, counter examples, quizzes, questions, displays, analogies, etc.); b) actions (test, summarize, define, define, interrupt, demonstrate, implication, application, teach procedure); and c) tasks (teach step by step, ask student, move on, stay here, go back to topic) in the framework (González & Mora, 2014). Furthermore, tutoring modelling is closely related to student modelling by using the students' knowledge to create their goal structure in an instructional activity (Marouf et al., 2018).

### 2.6.4 User Interface Component

The user interface model is known as the communication model. It includes the

aspects of human-computer interaction required to understand and support learning (Banawan et al., 2023). It is also referred to as the communication component of an ITS since it manages how students and the trainer or the system interact (Akyuz, 2020). Moreover, the channel by which students can request tutoring from the ITS to assess their solutions or where the ITS can respond right away based on the student's actions (Paladines & Ramírez, 2020). It gives students access to the learning materials and manages their engagement and communication with the system (Banawan et al., 2023). The User Interface model also enables the system to receive student exercises and solutions (Castro-Schez et al., 2021). User Interface is how the student interact with the tutor which is by using text, speech, sketches and clicks (Morgan et al., 2020).

## 2.7 Summary

Nowadays, it can be concluded that learning handwriting frameworks mostly use the Intelligent Tutoring System (ITS) in their application. Each existing framework uses different components to reach its objectives. Furthermore, the existing framework uses the Intelligent Tutoring System (ITS) and different modules or features to develop handwriting games. Moreover, all the components have their role that needs to be implemented to reach the goal of the effectiveness of the learning handwriting framework. Islamic calligraphy has many types; for this handwriting application, only two types will be used: Naskh and Thuluth. Different types of Islamic calligraphy have different styles of writing and art. Besides, the evaluation methods for this research study use the Content Validity method to evaluate the I-HATIC framework. In contrast, users will evaluate the interactivity of the tutoring Islamic calligraphy handwriting application. It evaluates the suitability of the components in this framework for handwriting applications.

# CHAPTER 3
# RESEARCH METHODOLOGY

## 3.1 Introduction

This research methodology will be separated into different phases and discussed in this chapter. The research methodology in this study is divided into four phases: *(i) Problem Investigation, (ii) Framework Development and Validation, (iii) Framework Evaluation* and *(iv) Documentation.*

The first phase is problem Investigation, where the data is collected regarding selected keywords such as *handwriting calligraphy*, *tutoring systems, Islamic calligraphy*, *handwriting tutoring applications* and interactive, and related issues through literature analysis from articles, journals, and proceedings. A preliminary study was also conducted to identify the problem of learning Islamic calligraphy and the improvement needed in the Islamic calligraphy application.

The second phase focused on framework development and validation. In this phase, the Intelligent Tutoring System (ITS) is used as the foundational framework to be enhanced and adapted into the new development framework, the Interactive Handwriting Islamic Calligraphy framework (I-HATIC framework). During this phase, a detailed mapping process was carried out, comparing the tutoring application components from the ITS with the insights from the literature review. This process led to a draft of the Interactive Handwriting Islamic Calligraphy framework (I-HATIC framework), which is integrated with established and newly identified components in the new framework.

Once the draft of the I-HATIC Framework was developed, it was sent to the panel of expert for their review, suggestions and opinions regarding the components implemented in the framework. The experts will validate the framework accurately through two (2) types of validation: *(1) Face validation* to ensure that the framework appears suitable and comprehensible at a surface level, and *(2) Content Validation* to confirm that the framework accurately reflects the underlying concepts and is comprehensive in its inclusion of relevant components. The feedback from panel

experts was critically important in this phase. The evaluation method that implements is quantitative approach by distributing a questionnaire to domain experts.

In the third phase, the prototype will be developed based on validation and expert feedback with a relevant interactive handwriting Islamic calligraphy framework (I-HATIC Framework) for handwriting application in Islamic calligraphy. This prototype targeted young generations aged 10 to 12 who intend to learn Islamic calligraphy. The Framework Evaluation: The participants will evaluate the prototype that applies the I-HATIC Framework. The user needs to explore and go through the application. After using the prototype, they need to rate the engaging experience.

Lastly, all data and information regarding the I-HATIC Framework development process are documented in the report. Figure 3.1 shows the overview of this study's research framework.

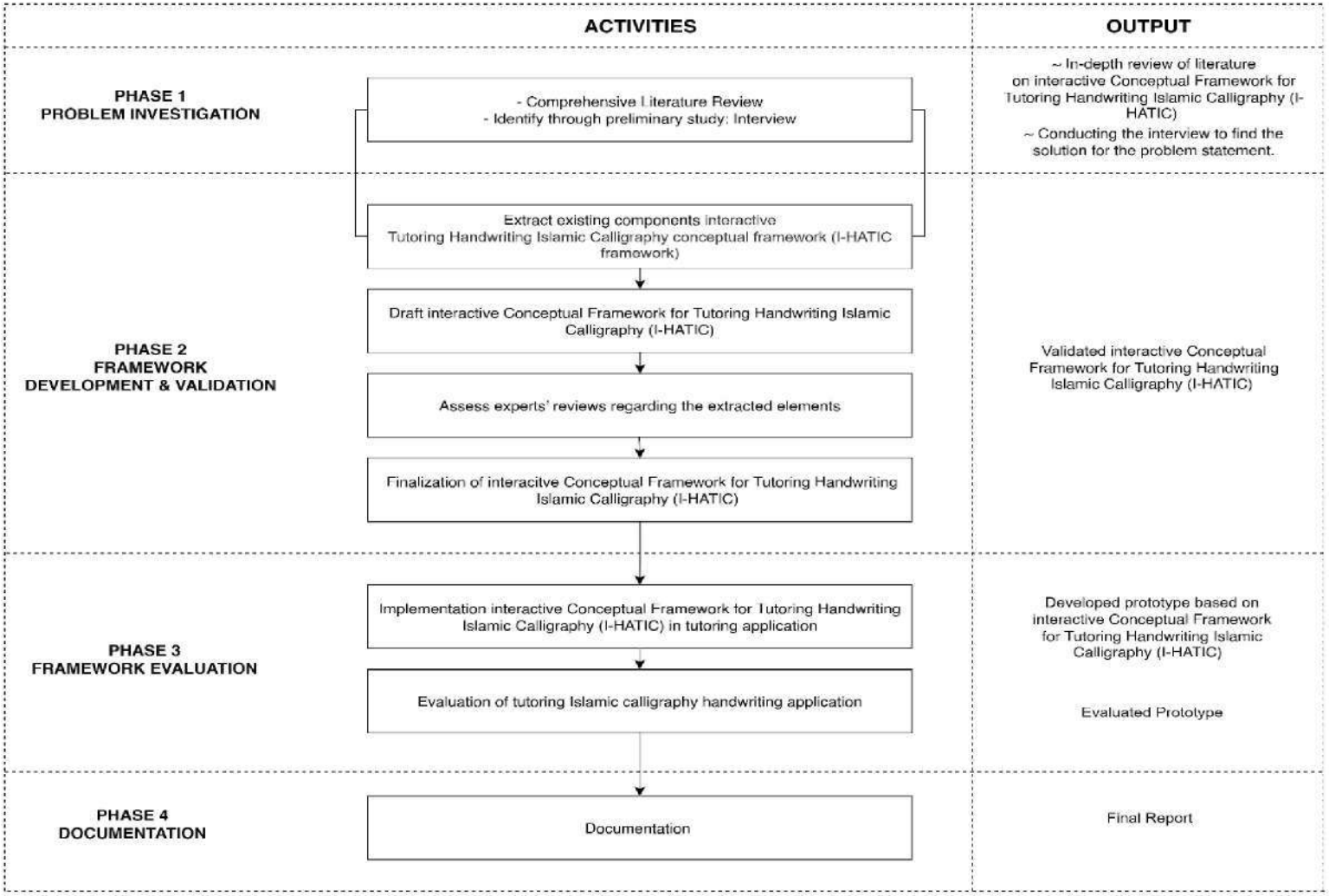



Figure 3.1 The Research Framework For This Study

Figure 3.1 above shows the research framework for this study. It shows phases and activities for each phase during this research period. The first phase is problem investigation, and the second phase is framework development and validation, which involves extracting from existing components the interactive Tutoring Handwriting Islamic Calligraphy conceptual framework (I-HATIC) and making a draft framework to review by the experts. In this phase, the experts also evaluate and give some opinions and comments on this I-HATIC framework, whether each component is relevant or not. After evaluation from the experts, the finalisation component for the I-HATIC framework. Next, the third phase is framework evaluation. The component will be implemented in a prototype and distributed to the user for testing, and the user will evaluate this application. Lastly, the final phase is documentation, the final report that will be made and can be used as a guideline for those who want to research handwriting applications.

## 3.2 Phase 1: Problem Investigation

The first phase is to recognize the problem faced by finding an answer to this question: *1) What is the problem?, 2) Why is it a problem?, 3) Where is the problem occurring?, 4) Who is experiencing the problem?, 5) When is the problem occurring?, 6) How was the problem observed?,* and *7) How often was the problem observed?.* The first question *is, what is the problem?* It is because of a limited framework for interactive tutoring of handwriting Islamic calligraphy, while the second question is, *why did it happen?* This study discovered that the input technique utilised in an imperfect device, like scribbling with a computer mouse, might negatively impact the student's performance compared to a touchscreen device (de Morais & Jaques, 2022).

The next question is where the problem happened and who is experiencing it. It has occurred and has been experienced by young generations, calligraphy experts and teachers who want to learn through digital means. Next, when the problem occurs, students do not have enough time to attend classes. The last question is how the problem was observed when users grew interested and lacked interactivity in the application and how often the problem was observed. According to expert En Muhammad Syazzan, most calligraphers are uninterested in teaching and afraid to publicly expose themselves to teach younger generations. Consequently, these studies construct the research

questions, objectives, and scopes. The data research consists of a preliminary study, an interview, and some literature studies related to this research.

### 3.2.1 Comprehensive Literature Review

A comprehensive literature review was conducted in this phase, using articles, journals, and books to determine the initial extracted list of existing components in the framework. Moreover, the comprehensive literature review can find the appropriate component to develop an I-HATIC framework. Topics through literature review from journal and proceedings articles with keywords related to the research, such as Interactive Handwriting Application, Islamic Calligraphy, Islamic Handwriting Application, Tutoring System, Interactive Tutoring System and Tutoring Handwriting Application. Details of the literature review are in Chapter 2.

### 3.2.2 Preliminary Study - Focus Group

Focus groups are more than just a way to give the project more numerical weight. They encourage conversation among members to bring up concepts that might not have come up outside of the group (Gandy, 2024). A focus group was the best method, and it was convenient to collect data from several people simultaneously and quickly (Kitzinger, 1995). An online focus group is a more appealing option for collecting data using Internet-based communication, such as WhatsApp, Google Meet and Zoom (Rivaz et al., 2019). According to Bouchard, Barsaloux and Drauden (1974) it confirmed that same four and seven members group, Osborn (1953) the founder of the techniques suggest 5 person group but not more than ten while Slater (1958) consider five members group as ideal solution in case of human relationship discussion but these findings contrast other findings that emphasize that the number of ideas created decreases with group size (Cortini et al., 2019). The preliminary study, which focused on a group of experts, was conducted to investigate the real situation related to this study. The interview was conducted with three well-known experts: Islamic calligraphy experts, game designers, and game developers. The interviewer will read the background research to familiarize the expert with this research and build good

relationships at the beginning of the focus group approach. In the focus group, the researcher will ask some questions, and the expert will give rational answers to the questions and opinions related to this research area.

#### *3.2.2.1 The Experts*

The inclusion criteria for eligible experts identified for this focus group must meet these criteria: 1) be experts in writing Islamic calligraphy, 2) know about Islamic calligraphy, and 3) have experience teaching Islamic calligraphy. This focus group involved four experts, including the researcher, to record the related field notes. The ages of their expertise range from 10 to 12 years old to above. The focus group session data was recorded to support the problem statement.

#### *3.2.2.2 Procedure and Data Collection*

The process begins with identifying the objectives of focus groups and the key research objectives to seek a straightforward process (Nyumba et al., 2017). A list of questions is prepared and given to participants to read before starting the focus group discussion. The focus group discussion was conducted online via Google Meet (due to COVID-19) and involved four tutors in Islamic calligraphy.

At the beginning of the session, five minutes were allocated to a brief introduction and a friendly environment. This focus group session should be relaxed and encourage people to talk to each other and share some knowledge (Kitzinger, 1995). The experts should also be informed that personal data will be recorded and kept confidential. The researcher facilitated the discussion using the questions provided in Table 3.1.

Table 3.1
List Of Questions For The Focus Group Interview.

| Questions |
| --- |
| **1.** What did you do before/during/after attending the teaching activities? Why did you do so? |
| **2.** When did you realize that limited teachers or trainers teach Islamic calligraphy? |
| **3.** How did you and the calligraphy trainer train students to write calligraphy letters smoothly? |
| **4.** Why did you say that calligraphy handwriting needs more practice is important? |
| **5.** Why did you ensure that students always need to listen to the teachers or calligraphy trainers and stay focused during the lectures? |
| **6.** Why did you change the strategy to attract students to enjoy learning calligraphy handwriting? |
| **7.** If you could think of using a calligraphy handwriting game application to support training, which strategy would you maintain? Why? |

### *3.2.2.3 Focus Group Findings*

Based on the focus group approach, the experts said most problems in handwriting Islamic calligraphy are limited to well-trained trainers teaching Islamic calligraphy in schools or institutions. Furthermore, there is limited interaction in tutoring Islamic calligraphy among the young generation to attract them to learn Islamic calligraphy. In addition, there is a limited framework for interactive tutoring of handwriting Islamic calligraphy, and the devices used in teaching need to be suitable for writing calligraphy.

Table 3.2 Shows An Overview Of The Phase 1 Problem Investigation.

Overview Of Phase 1 Problem Investigation

| Phase | Activity | Method of Data Collection and Analysis | Sampling Design | Procedure and technique / experimental setup |
|---|---|---|---|---|
| Phase 1 | Comprehensive Literature Review | • The problem was investigated through an extensive literature review.<br>• A comprehensive literature review was conducted to determine the initial extracted list of existing components in the framework. | Topic through LR from journal and proceedings articles with the keywords related to the research, such as:<br>• Interactive Handwriting Application<br>• Islamic Calligraphy<br>• Islamic Handwriting Application<br>• Tutoring System<br>• Intelligent Tutoring System<br>• Tutoring Handwriting Application | Procedure to investigate the problem with an answer to this question:<br>• What is the problem?<br>• Why is it a problem?<br>• Where is the problem occurring?<br>• Who is experiencing the problem?<br>• When is the problem occurring?<br>• How was the problem observed?<br>• How often was the problem observed? |
| | Conduct a preliminary study to interview the experts. | • Conduct a focus group with the experts. | | The procedure for conducting this preliminary study is to prepare the questions for the experts. |

Table 3.3
Overview Of Phase 2 Framework Development And Validation

| | Activity | Method of Data Collection and Analysis | Sampling Design | Procedure and technique / experimental setup |
|---|---|---|---|---|
| | Extract a list of existing/new components of the interactive tutoring system. | Content Analysis | The component is extracted, and enhancements are made from the existing framework. | • Investigate through an extensive literature review to find the components related to this study.<br>• The components will be extracted from the existing model, framework, or theory related to this study.<br>• Combine existing and new components that are related to this study. |
| 2 | Assess experts' reviews regarding the extracted components | • Face Validation<br>• Content Validation | • The draft framework, which includes game design, will be sent to the research domain's academic experts for validation through a questionnaire.<br>• For this purpose, some experts/professionals who are well-known in their respective fields, especially game design experts and Islamic calligraphy experts, will be contacted to comment on the proposed framework draft. In light of experts' opinions, necessary amendments will be made to the framework. | • The experts' panel consists of specialized academic game researchers and game-industry-related professionals.<br>• These experts are in the field of Islamic calligraphy. |

## 3.3 Phase 2: Framework Development and Validation

The second phase involves developing and validating a conceptual interactive framework for tutoring in Islamic calligraphy handwriting (I-HATIC Framework). Developing this framework needs to be done thoroughly. The framework components were extracted from the relevant existing model, framework, or theory related to this study through content analysis and expert validation. Table 3.3 shows the overall process of phase 2: framework development and validation.

### 3.3.1 Content Analysis

Content analysis is a scientific approach to media and communication interaction that is the foundation for conclusions and theories regarding content research (K. Hasan, 2024). Moreover, it involves methodical content analysis to find crucial data addressing research issues (Baytak, 2024).

#### *3.3.1.1 Defining the Purpose and Research Questions*

The first step in applying content analysis is to establish the purpose of the study and the research questions that will guide the analysis. This research aims to extract relevant components from six selected interactive tutoring systems to develop a conceptual framework tailored for handwriting Islamic calligraphy, known as I-HATIC. The guiding research questions include: (1) What are the key components for interactive handwriting tutoring in the Islamic calligraphy framework (I-HATIC framework)? (2) How to develop an interactive Tutoring Handwriting Islamic Calligraphy framework (i-HATIC framework)? (3) How is the proposed I-HATIC Framework through tutoring the handwriting of the Islamic calligraphy application? These questions are the foundation for systematically exploring and interpreting each system's documented content.

*3.3.1.2 Selecting the Content for Analysis*

The second step involves identifying and selecting the relevant content to be analyzed. For this study, six interactive tutoring systems were selected based on their relevance to handwriting instruction, intelligent tutoring mechanisms, and engagement strategies. These systems are: (1) Djehuty Intelligent Tutoring System (ITS), (2) Handwriting-based Intelligent Tutoring Systems, (3) D'Nealian Handwriting System, (4) Writing Pal (W-Pal) System, (5) Gamification in Intelligent Tutoring Systems, and (6) Sketchtivity System. Primary materials used for analysis include academic publications, system documentation, demonstration videos, user manuals, and prior evaluations. These sources provide rich descriptions of system design, learning theories applied, interface components, and user interaction models, which are crucial for deriving a relevant framework for I-HATIC.

*3.3.1.3 Develop the Code Scheme and Code the Content*

In the third step, a coding scheme is developed to categorize and structure the analysis. This scheme consists of thematic codes representing critical aspects relevant to the I-HATIC framework. The coding categories were developed using a hybrid approach, both deductive and inductive. The main coding categories include Expert Model, Generativity Model, Student Model, Mixed-initiative Model, Instructional Module / Tutoring model, Interactive Gaming Environment Model / User Interface Model and Strategy Model. Each of these categories reflects a possible design element to be included in the conceptual framework for I-HATIC.

The next step involves applying the coding scheme systematically across the selected systems. Each document, paper, or media file related to the six systems is reviewed, and relevant data are identified and coded according to the predefined categories. A matrix table captures specific components and criteria. Table 3.4 shows the process of the coding scheme and the coding of the content.

Table 3.4
Process Coding Scheme And Coding The Content

| | ITS components | Description | Criteria |
|---|---|---|---|
| Djehuty ITS | Expert model and generativity | • To evaluate the students and the system, compare the order of the lines produced with the reference. | The student gets a score in stars by clicking on the star button. The more accurate the replication, the higher the score. If the user got more than 3.5 stars, the following letter is sampled in the user's style.<br>The player requests the application to write a letter on the screen.<br>The player can sample many examples of the same letter in real-time by clicking the refresh button. |
| | Student model | Evaluate the angular distance between the student trial and the sample to measure performance. | The player tries to replicate the letter she wants by drawing on the screen. |
| | Mixed-initiative | • The learner chooses which letter to draw, leading the task initiative, and the AI proactively refines the task by posing a specific challenge. | The player can retry as many times as she wants, as the AI produces a new shape for the same letter after a player gets a score; otherwise, the player can exit the main menu with the back button. The goal is to get as many stars as possible in all letters. |
| | Interactive learning | a system that is responsive to the student | The system compares the order of lines produced with the reference to evaluate the student. |

| | | | |
|---|---|---|---|
| Handwriting-based ITS | Student modeling | It is necessary to consider the context of the problem to be solved to refine the handwriting recogniser students use. | Collection of user strengths and weaknesses, in particular, user performance |
| | Tutoring model | The tutoring system detected that an error had been made. | Provide step-by-step feedback to help the user with their work. |
| D'Nealian Handwriting System | Student model | Student inputs the required key letter | Player progress shows through the game level by increasing the difficulty as they work through the game world. |
| | Teacher evaluation and feedback module | • It provides feedback and guides on how to correct errors. | Provide feedback on the children's work and guide them in correcting the error. |
| | Interactive environment | • Students play in a game environment | Provide a game environment and interaction between the system and children |
| W-Pal System | Strategy model | It used multiple strategies in the strategy module to study and practice in any order in Writing Pal. It combines strategy instruction, game-based practice, essay writing practice and automated formative feedback. | Contain a lesson video before the lesson introduction. |
| | Teacher evaluation and feedback module | To win, students must correctly answer more questions than their computer opponents do. | Checkpoints - Students who want to win must answer the questions correctly compared to computer opponents |

| | | | |
|---|---|---|---|
| Gamification in ITS | Expert Module | It was implemented to gather the information to generate student feedback | It provides proper feedback in response to the student's answer |
| | Student Module | Student profile information | Score: It is viewed as describing a student's performance |
| | Tutoring process module | It works as a coordinator that controls the functionality of the system | Control: It acts as a coordinator to control the functionality of the whole system |
| | interactive gaming environment/ User Interface Modelling | Integrate the information needed to interact with the user | Interaction with the user of the system to collect the information |
| Sketchtivity System | Student Model | Users can unlock any task to access more advanced lessons. | • Score and leaderboard: to motivate users to enjoy the competition |
| | Expert Model | It provides feedback on each sketch's accuracy, line quality, and speed. | • It provides feedback on each sketch's accuracy, line quality, and speed. |
| | interactive gaming environment | It contains a sketch-based game that allows users to practice basic line work. | • It provides a game concept to make user practice more fun and feel less like a chore. |

#### *3.3.1.4 Analyze and Interpret the Results*

Once the content has been coded, the next step is to analyze the data to identify patterns, similarities, and gaps across the six tutoring systems. A thematic analysis is conducted to group recurring features and innovations that could inform the design of I-HATIC. Table 3.4 shows a matrix table to highlight which components are most commonly adopted and which are unique to specific systems. Simultaneously, the analysis considers the suitability of each identified feature within the cultural and pedagogical context of Islamic calligraphy tutoring, ensuring relevance to both learners and content.

Based on Table 3.5, the development process of the I-HATIC Framework was developed based on content analysis within relevant theoretical fundamentals for interactive tutoring systems. The I-HATIC framework has successfully adopted four core models: the Expert Model, the Student Model, the Instructional/Tutoring Model, and the Interactive Interface Model. These provide a strong instructional backbone for instructing Islamic calligraphy through intelligent and interactive means. From six theoretical fundamentals, use these four models always in each handwriting framework. These four models can give feedback, guideline, and interactive in developing handwriting application.

Table 3.5
A Matrix Table To Highlight Which Components Are Most Commonly Adopted

| **Components** | **Relevant Theoretical Fundamentals** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Djehuty ITS** | **Handwriting-based ITS** | **D'Nealian Handwriting System** | **Writing Pal (W-Pal) System** | **Gamification in ITS** | **Sketchtivity System** | **I-HATIC Framework** |
| Expert Model | m | | m | | m | m | © |
| Generativity Model | m | | | | | | © |
| Student Model | m | m | m | | m | m | © |
| Mixed-Initiative Model | m | | | | | | © |
| Instructional Model / Tutoring Model | | m | m | m | m | | © |
| Interactive Gaming Environment Model / User Interface Model | m | | m | | m | m | © |
| Strategy Model | | | | ® | | | © |

*3.3.1.5 Develop the Conceptual Framework*

The fifth step is to synthesise the analysed data into a structured conceptual framework for I-HATIC. This framework consolidates the essential components identified through the content analysis. The initial draft framework is presented as a table with items showing how each component contributes to the interactive tutoring of Islamic calligraphy in a digital environment.

Next, the process establishes the precise operational definitions for each component. This was done to ensure a comprehensive understanding and provide clarity and relevance for consistent interpretation and application throughout the research study. Table 3.6 represents the operational definitions of the components in the I-HATIC Framework.

Table 3.6
The Operational Definition Components In The I-HATIC Framework

| Components | Operational Definition |
|---|---|
| **Student** | It contains student calligraphy handwriting performance information. |
| **Tutoring** | The decision to continue tutoring strategies through a manual guideline is based on the information from the student component. |
| **Expert** | The source of expert knowledge and a standard for evaluating and responding to the student's performance. |
| **Interactive Interface** | A type of information that integrates to interact with learners through graphics, text, video, audio and animation. |

The criteria for each component were also meticulously extracted. These criteria were the instrument items for the I-HATIC Framework. Table 3.7 illustrates the I-HATIC Framework, which has undergone several processes. These four components and their criterion provide better user engagement and enhance the user experience to be more interactive in the interaction between the user and the application. Next, all the components and criteria of the I-HATIC will be sent to the experts for review and validation.

Table 3.7
The Criteria For Each Component Of The Instrument In The I-HATIC Framework

| Components | Criteria |
|---|---|
| **Student** | I can trace the calligraphy letter |
| | The tutoring apps show the user's score |
| | I can choose the difficulty level |
| | The tutoring apps show the user's performance |
| **Tutoring** | The tutoring app has a tutorial that is easy to follow |
| | The tutoring app gives feedback on the user's success or failure |
| | I will be guided in correcting the error |
| | The tutoring app gives a sense of control over the interaction between calligraphy letters. |
| | The tutoring app offers a reward for the correct answer. |
| **Expert** | The tutoring app gives feedback on the user's writing |
| | The tutoring app allows the user to practice handwriting letters. |
| | I can retry the handwritten letter |
| | The tutoring app responds to letter accuracy |
| | The tutoring app responds to a line quality |
| **Interactive Interface** | The tutoring app offers interaction based on user preference |
| | The tutoring app offers easy to practice environment |
| | The tutoring app offers fun learning |
| | The tutoring app provides video and audio auxiliaries in practicing calligraphy letters. |

### 3.3.2 Assess Expert Validation

To evaluate and validate the compatibility of the Interactive Tutoring Handwriting Islamic Calligraphy framework (I-HATIC Framework) components in the Islamic calligraphy handwriting application by the experts. The study will implement a quantitative approach by distributing a questionnaire to domain experts such as developers and Islamic calligraphy experts. The questionnaire aims to assess experts' opinions regarding the draft framework, in which the components are extracted from the comprehensive literature review and interviews. The draft framework will be distributed to the experts for validation. Some well-known experts in this study area

will be contacted to give their opinions and suggestions about the proposed framework. Figure 3.2 shows the steps to assess the expert validation for the I-HATIC framework.

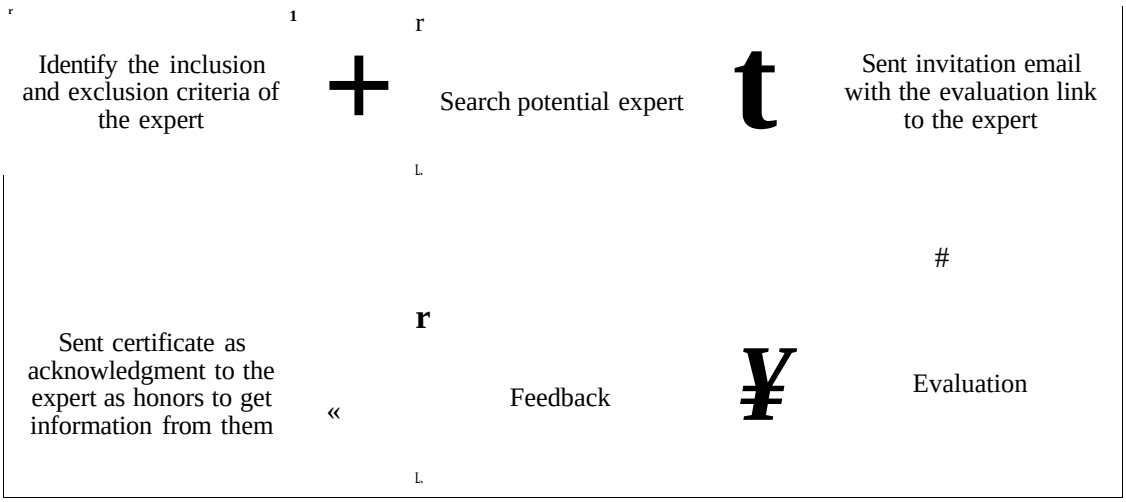



Figure 3.2 The Steps To Assess The Expert Validation For The I-HATIC Framework.

The first step to getting the expert's validation is identifying the inclusion and exclusion of the expert based on relevant position, experience, field of expertise and other qualifications related to the study's objective.

Inclusion and exclusion of the expert include:

The expert among academics was required to fulfil these criteria:

- A full-time lecturer
- Experts have at least five years of teaching experience
- Experts have at least one year of experiencing in developing mobile learning applications.
- Experts have qualification recognised by the Ministry of Higher Education.
- The experts among calligraphers (industry) were required to fulfil these criteria.
- Have at least one year of experience in teaching Islamic calligraphy.
- Have a qualification related to Islamic calligraphy.

For the exclusion criteria:

- The incomplete data from the experts will be excluded from the research procedure.
- The experts do not have a consent/ survey form. He/she does not have the right to be involved in this research.

The first step to getting the expert's validation is identifying the inclusion and exclusion of the expert based on relevant position, experience, field of expertise and other qualifications related to the study's objective. Following this, a thorough search was conducted using trusted sources such as academic databases, professional networks and institutional websites such as:

- *http://www.expert.uitm.edu.my*
- *and http://www. usim. edu. my/usim-expert*
- *http://expert.unimas.my*
- *http://www.myexpertfinder.uthm.edu.my*

Moreover, other related websites are used to gather detailed information about potential experts who meet the inclusion criteria requirements. Once appropriate experts were identified, the email invitation was drafted, outlining the study's purpose and the role they were expected to play and providing the link to the necessary evaluation materials. A deadline, typically within two weeks, was set for their response. In cases where the responses were not received, a follow-up email was sent to remind them of the importance of their participation and offer an extended deadline. Table 3.8 shows the components needed in an invitation email for the experts.

Table 3.8
Components Of An Invitation Email For A Content Expert

| Paragraph | Sample text |
|---|---|
| State of the purpose of the study | I request your valuable opinions, suggestions or recommendations regarding the Conceptual Framework for Interactive Tutoring Handwriting Islamic Calligraphy (I-HATIC Framework). |
| Briefly describe the instrument. | As an expert in the field, I would greatly appreciate your feedback on validating this framework. I would appreciate your assessment of each item's relevance and clarity to improve the proposed framework. |
| Describe how to contribute to a study. | I am eagerly awaiting your feedback. Kindly provide your feedback using the Expert Review link within two weeks, preferably by March 14,2024. To begin the review process, please confirm your participation in this study by clicking on this link. *Expert Review Form* |

| | |
|---|---|
| Contact Information and Thank you. | Thank you for your cooperation, time and assistance. Please find attached a letter of appointment as an expert reviewer. Once again, thank you in advance for your time and effort in making this research successful. If you have any questions, please do not hesitate to contact me at *sabihahjamaluddin95@gmail.com (019-674 7104)* |

Source: (Hidayah Mat Zain et al., 2016)

Once the expert agrees to contribute, they must complete the evaluation form provided in the email. The expert's role involves critically assessing the initial draft of the I-HATIC framework based on the specified criteria of each component in the framework. They are expected to review the content thoroughly, offering revisions or suggestions for improvement where necessary. Moreover, the expert evaluates whether the component is relevant or clarified in the I-HATIC framework.

After completing the review draft of the I-HATIC framework, the expert submits the evaluation, including the amendments needed. The expert provides detailed feedback on the evaluation form, outlines their rationale for the changes, and offers insights into the overall content. If the expert identifies any issues or problems that need significant change, the expert must contact the researcher directly through email or the contact number provided in the invitation email.

To acknowledge the experts' contribution to evaluating and validating this study, an e-certificate will be provided as a formal token of appreciation. Finally, a thank-you email was sent upon the expert's completion of their involvement, which included information regarding the honorarium and the collaborative effort of the other expert in this study.

#### *3.3.2.1 Face Validity for the I-HATIC Instrument*

Face validity is the degree to which a measure appears to be related to a given construct, according to non-experts such as test takers and legal system representatives (Taherdoost & Hamta, 2017). It evaluates the instrument in terms of feasibility, readability, consistency of the style formatting and the clarity of the language used (Taherdoost & Hamta, 2017). According to Oluwatayo (2012), the quantitative evaluation of face validity can be accomplished by asking research specialists or interested individuals not trained in psychometrics to rate how well the measuring tool

fits its intended purpose. However, some previous researchers demonstrated that in the test of evidence of face validity, the target population must confirm to be clear and understandable, relevant, easy to answer and not judgmental, intrusive or distressing to the audience (Allen et al., 2023).

According to Lynn (1986), face validity is an unqualified approach. However, it has continued to be confused with content validity, leading to content validity as a legitimate form of validity. Therefore, the author recommends quantifying the response by calculating the percentage of agreement, as shown in Table 3.9. The percentage for individual questions and overall agreement will be calculated using equations 1 and 2.

Table 3.9
Calculation Of Face Validation Agreement

| Equations | | |
|---|---|---|
| | Equation 1 | **No of agreed rates per question** / **Total number of ratersper question** * 100% |
| | Equation 2 | Sum of % of all questions / Total number of questions |

Source: (Patel & Desai, 2020)

Based on Table 3.10, the proposed guide for retaining, redefining, or restructuring the area covered under the previous questions and the overall instrument in I-HATIC. All the calculations in Face Validation will be shown in Chapter 4.

Table 3.10
Guidelines For Defining The Face Validity Agreement

| %of Ag;**reement** | **Strength of Agreement per question or Overall** | **Action for each Question / entire Instrument** |
|---|---|---|
| <80 | **Poor** | Restructure |
| 80-90 | **Substantial** | Revise |
| 90- **100** | **Full** | Retain |

Source: (Patel & Desai, 2020)

**The Procedures**

The experts involved in face validity are two experts who have been identified

and invited to examine the research instrument for face validity (LYNN, 1986), as shown in the table. Two inclusion criteria were used in choosing the experts as follows:

1. A full-time lecturer.
2. Academic experts with at least 5 years of experience in the Computer Science field (> 5 years).
3. Have a qualification recognised by the Ministry of Higher Education.

Table 3.11 shows the number of appointed expert panel members, their areas of expertise, and their years in their respective fields. All the appointed experts are academicians, specifically lecturers who specialize in this field of education.

Table 3.11
Expert For The Face Validation

| Expert | Expertise | Experience (Years) |
|---|---|---|
| **1** | Computer Science | 8 years |
| **2** | Computer Science | More than 10 years |

Each expert panel member will receive an official email appointment letter and a link to the evaluation form. The instrument will also be emailed with a cover letter, a summary of the I-HATIC Framework research, and the evaluation form. The instructions on completing the evaluation will be provided to ensure the process is smooth and straightforward. Once the evaluation is complete, the panel will submit their responses via Google Forms. This process ensures consistency, transparency, and ease of communication between the research team and expert panels.

**Expert Validation Instrument**

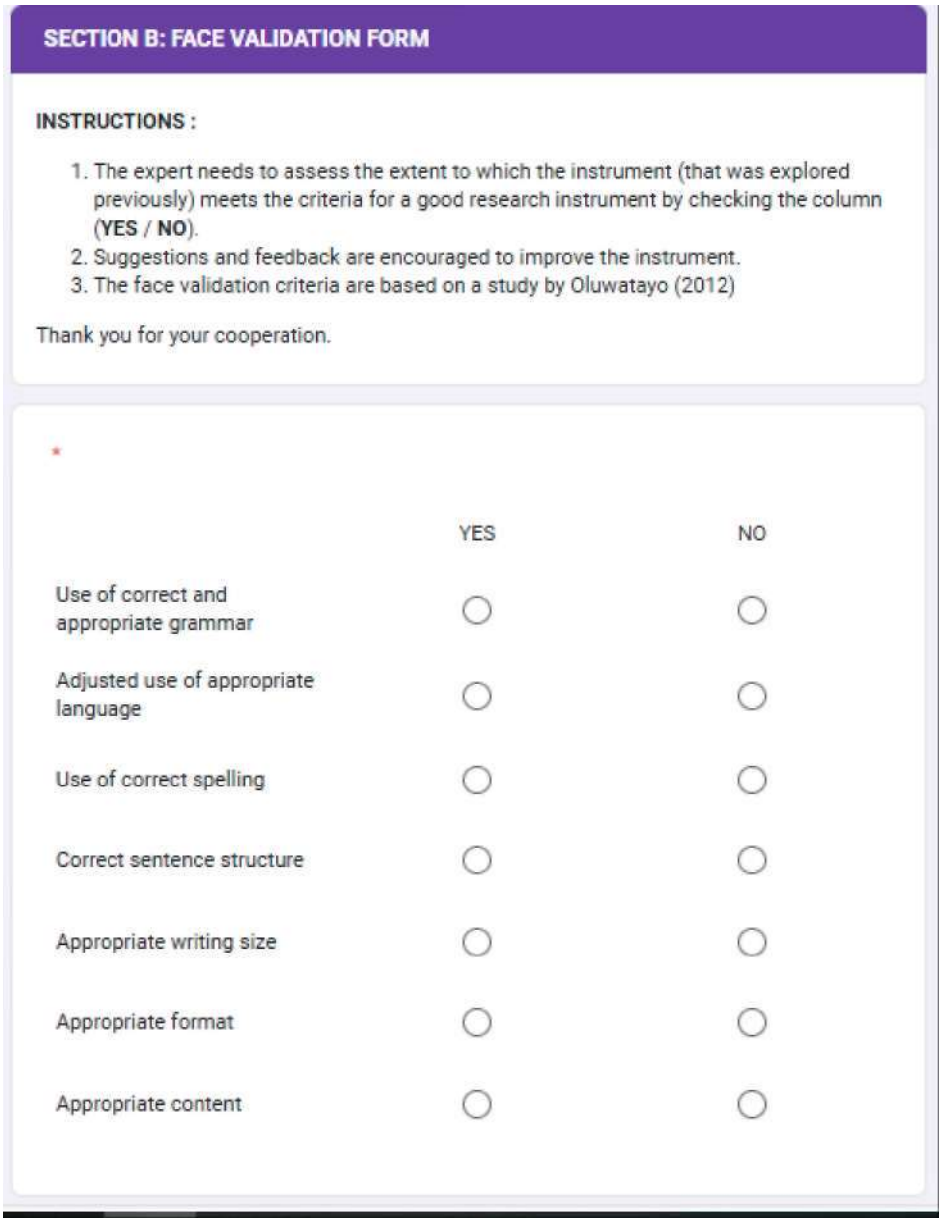
The instrument collects the demographic details of each expert, including their name, institution, position, field of expertise, and years of experience. This information helps contextualise their feedback and ensures their evaluations are relevant to their

professional background.

In the face validation sections of the instrument, experts are provided with comprehensive instructions to assess the suitability and effectiveness of the I-HATIC Framework questionnaires for their intended use. The validation process follows specific criteria outlined (Oluwatayo, 2012), which will be evaluated in terms of:

1. Use of correct and appropriate grammar
2. Adjusted use of appropriate language
3. Use of correct spelling
4. Correct sentence structure
5. Appropriate writing size
6. Appropriate format
7. Appropriate content

The feedback from the panel of experts was categorised into two responses: "YES" and "NO". A "YES" response signifies that the item is structured according to empirical standards and aligns with the thematic categories outlined by Sangoseni et al., (2013). This indicates that all the items meet the established criteria for organization and relevance within the specific themes. Figure 3.2 show the sample of face validation questionnaire.



**SECTION B: FACE VALIDATION FORM**

**INSTRUCTIONS :**

1. The expert needs to assess the extent to which the instrument (that was explored previously) meets the criteria for a good research instrument by checking the column (**YES** / **NO**).
2. Suggestions and feedback are encouraged to improve the instrument.
3. The face validation criteria are based on a study by Oluwatayo (2012)

Thank you for your cooperation.

*

| | YES | NO |
|---|---|---|
| Use of correct and appropriate grammar | ○ | ○ |
| Adjusted use of appropriate language | ○ | ○ |
| Use of correct spelling | ○ | ○ |
| Correct sentence structure | ○ | ○ |
| Appropriate writing size | ○ | ○ |
| Appropriate format | ○ | ○ |
| Appropriate content | ○ | ○ |

Figure 3.3 The Sample Of Face Validation Questionnaires

Furthermore, the expert panel was encouraged to provide additional comments and suggestions to refine and enhance the I-HATIC Framework instrument. These insights are valuable for making necessary adjustments or any amendments to improve the clarity, effectiveness, and overall quality of the I-HATIC framework instrument.

### *3.3.2.2 Content Validity for the I-HATIC Instrument*

Content validity determines whether or not a framework component is valid. This study implemented content validity by identifying the central concept of the theory and the quantitative approach to determine if the construct measures the central concept of the theory (Newman et al., 2013). Besides, content Validity is the area that covers which items on the instrument are sampled and accepted from the specified domain of content (Almanasreh et al., 2019). Furthermore, it provides evidence about the degree to which elements of the assessment instrument are relevant and representative of this study, targeted for a particular assessment purpose (Almanasreh et al., 2019).

This study explores the analysis using the *Content Validity Ratio (CVR), Item Content Validity Index (I-CVI),* and *Scale Content Validity Index (S-CVI)* in the process of evaluating the draft I-HATIC Framework. The experts were asked to respond autonomously to the questionnaire and rate on a point rating scale for the *Relevant* and *Clarity* components. Figure 3.8 shows the calculation for the CVR, while Table 3.12 states the formula for calculating each of the I-CVI and S-CVI. Based on experts' opinions, necessary amendments will be made to the draft I-HATIC Framework. The next chapter can refer to all the detailed calculations and results of the expert feedback.

### *3.3.2.3 Content Validity Ratio (CVR)*

One approach for the experts to achieve content validity is to consider the relevance of individual items within the instrument (Almanasreh et al, 2019). CVR using Lawshe's method is the most common method used for quantifying content validity by inviting a panel of experts. In the CVR approach, experts will rate each item into three categories: *Essential, Useful but Not Essential,* or *Not Necessary* (Almanasreh et al., 2019).

$$CVR = \frac{n_e - \{N/2\}}{N/2}$$

CVR =content validity ratio; $n_s$= Number of panel members indicating an item 'essential' N = Number of panel members

Figure 3.4 Formula For Calculating CVR (Ayre & Scally, 2014)

#### *3.3.2.4 Item Content Validity Index (I-CVI)*

After the item is recognised as the final instrument, the I-CVI or CVI is calculated for the entire instrument, representing the average CVR value of the retained items (Almanasreh et al., 2019). The CVI is calculated based on the expert rating for each item based on the relevance or representativeness of the instrument, usually a 4-point Likert scale that ranges from 1 (not relevance) to 4 (relevance), which is by the counting expert who rated as 3 or 4 and dividing the number of the total number of experts and that the proportion of the agreement about the content validity of an item (Almanasreh etal.,2019).

#### *3.3.2.5 Scale Content Validity Index (S-CVI)*

Scale Content Validity Index (S-CVI) is defined as the proportion of the total number of items judged as content valid or the proportion of items on the instrument that achieved ratings of 3 or 4 by the content expert (Zamanzadeh et al., 2015).

Table 3.12
The Formula For Calculating I-CVI And S-CVI

| Item | Formula |
|---|---|
| I-CVI (Item-level content validity index) | I-CVI = (agreed Item)/ (number of experts) |
| S-CVI/Ave (Scale-level content validity index based on the average method) | S-CVI /Ave = (sum of I-CVI scores)/ (number of items) |
| S-CWUA (scale-level content validity index based on the universal agreement method) | S-CWUA = (sum of UA scores)/(number of item) |

(Source: (Yusoff, 2019))

## 3.4 Phase 3: Framework Evaluation

A prototype application must be developed based on a validated I-HATIC Framework by experts. After developing the prototype, users will evaluate it. The questionnaire will be distributed to the user to evaluate the interactivity of playing this handwriting application. The target users will be aged 10 to 12 years old.

Furthermore, developing an interactive Islamic calligraphy handwriting application is a critical phase. The ADDIE Model is a suitable method for developing the prototype. It is designed to enable educators to create and develop successful learning experiences by offering a defined framework (Moses Adeleke Adeoye et al., 2024). Moreover, the ADDIE Model is expected to develop instructional strategies to strengthen the connection between learning theory and instructional system practices (Handrianto et al., 2021). Figure 3.5 show ADDIE Model consists of five phases: *Analysis phase, Design Phase, Development Phase, Implementation Phase* and *Evaluation Phase*. Several development iterations may occur within a user and a development phase to refine an application based on user testing feedback.

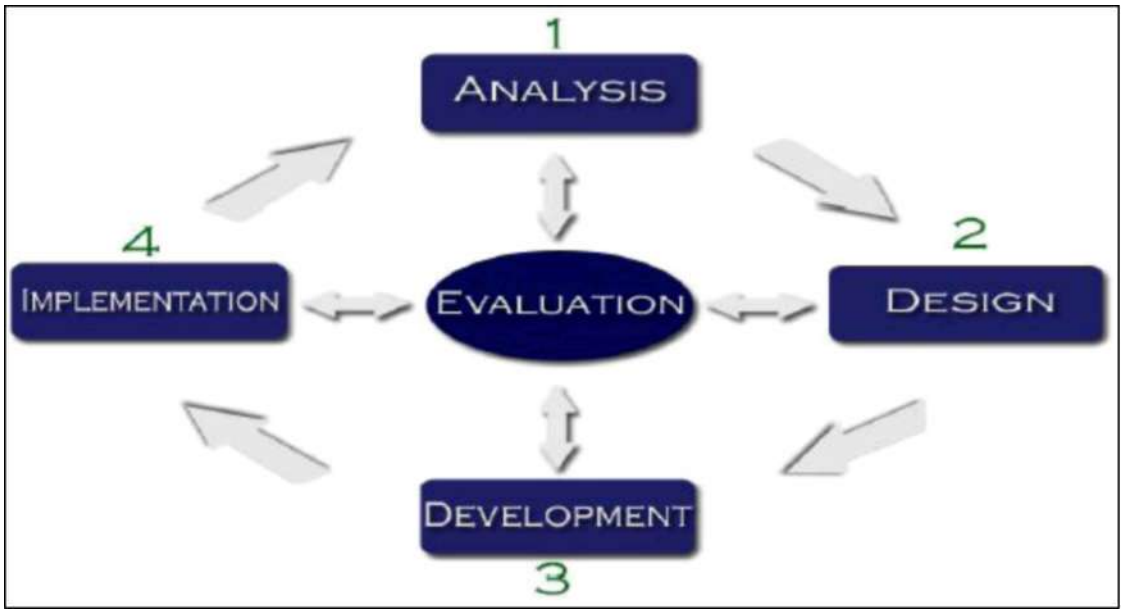



Figure 3.5 ADDIE Model Cycle
source: (Manjale Ngussa Ag, 2014)

### 3.4.1 Development Prototype

A development prototype is an early version for the development of the application to test functionality and identify technical issues and the interactivity between the user and the application. The ADDIE Model is used during the development prototype process to help the developer develop the application step by step.

#### *3.4.1.1 Analysis Phase*

The first phase in the ADDIE model is the *Analysis phase*, which analyzes the problem statements, project scope, project objectives, research methodology, and significant and expected outcomes of developing this application. Numerous resources are expended to collect the information, such as interviews, surveys, online journals, articles and e-books. These methods are used to find information and solutions for the project objectives, problem statement, scope, and literature review. The strengths and weaknesses of the project will be pointed out to improve and produce a better Islamic Calligraphy Handwriting application. This phase also needs to examine similar applications that may be sufficient for users or lack certain aspects. It also determines the target user suitable for this application and the information that needs to be generated.

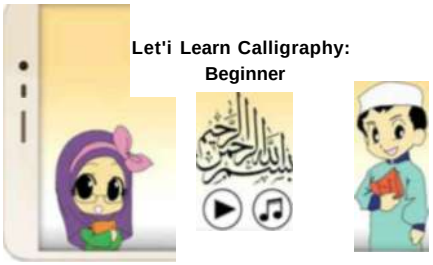
It can also use preliminary studies, such as surveys and interviews, to get information about the project's problem statement, scope, significance, and objectives. According to an interview with experts, the problem statement, knowledge, and significance are required to ensure that it meets the user's requirements. While a calligrapher has made up the survey to analyse the problem statement, it meets this project's objectives. The survey was distributed among beginners to determine whether they need to learn calligraphy through a mobile application or vice versa. The survey was conducted using a questionnaire that was distributed using Google Forms. At the same time, the interview was conducted by interviewing three experts to learn the details of calligraphy. Lastly, all the collected information will be adequately documented for the following development process.

#### *3.4.1.2 Design Phase*

The next phase is the design phase, a design process phase. The design process involves the information from the analysis phase to develop the Islamic Calligraphy handwriting application. Besides, the storyboard was prepared to visualise the flow of the application in the development process. Table 3.13 shows the part of the user design phase, which is the application's storyboard from the start page to other scenes. Figure 3.5 shows the navigational map of the application for the other scenes.

Table 3.13
The Storyboard Of The Handwriting Islamic Calligraphy Application

**1. Home page**




Home page Let's Learn Calligraphy: Beginner. The interface is simple and contains an animation, a button to play, and a button for sound, which can turn on or off the background music.

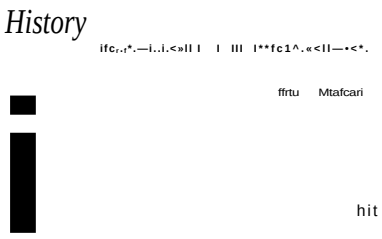
**2. Main Page**


The Main page contained the button About Khat, a video and a button for the user to try writing the calligraphy.

**3. About Khat**

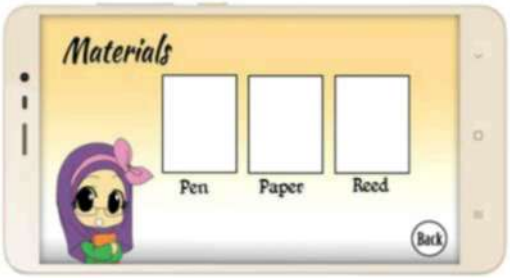

Regarding the khat interface, the user can choose the button for history, the button for the type of khat, and the button for the materials that can be used to write calligraphy.

**4. History**



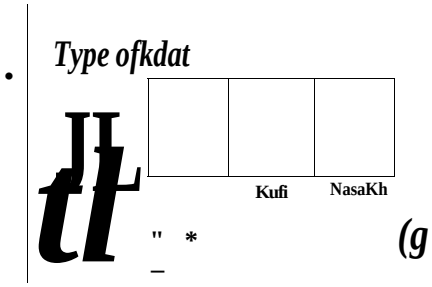

The user can read the history of calligraphy at the history interface, click the button to return to khat, and turn off the narration sound.

**5. Materials**



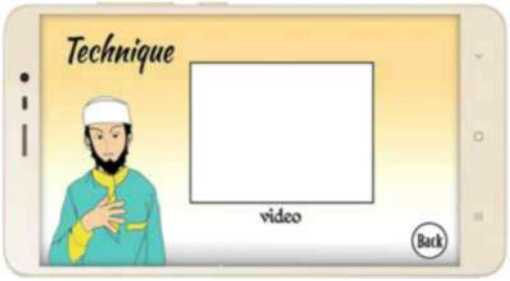

In the materials scene, the user can know that the materials can be used to write calligraphy in real life. The button back will be provided to the user to go back to the About Khat.

**6. Type of Khat**




The type of Khat scene shows the famous calligraphy that calligraphers always use. A button will be provided so the user can return to About Khat.

**7. Technique**




A technique for writing a calligraphy scene is shown in the video. It can make users more attracted to watch. The back button will be provided so the user can return to About Khat.

**8. Try Me!**


Write here scene shows the scene where the user can try to write calligraphy with the guideline, which is the character can be a teacher to give the guide Button back has been provided for the user to go back to About Khat, button colour can make user change colour of pencil and button erase can make user erase the wrong text.

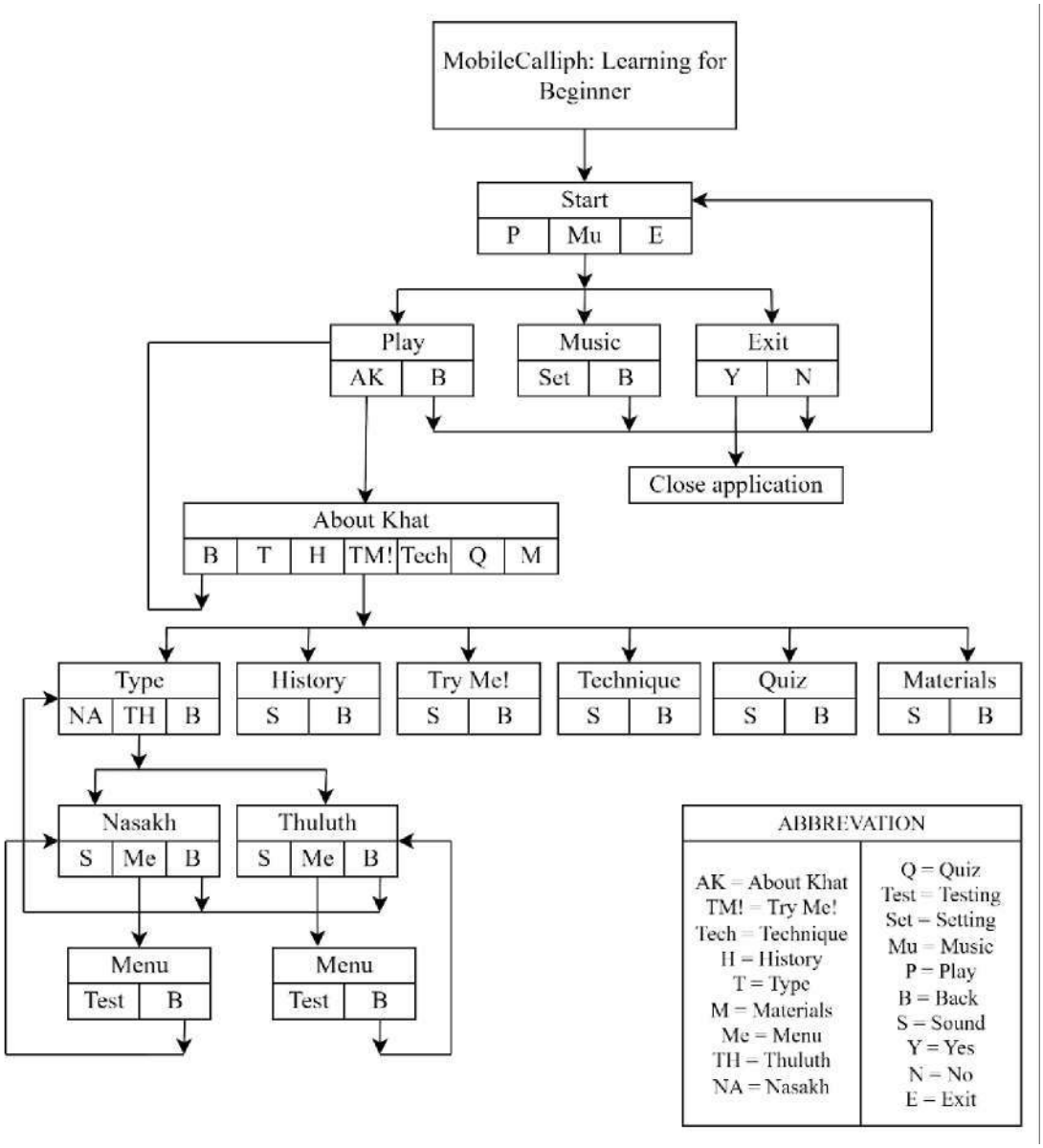



Figure 3.6 The Navigational Map

Figure 3.6 shows the navigational map of the MobileCalliph application that is used as the outline structure for the entire application. It is important to see the flow for each application. It shows each functional button in MobileCalliph application.

Tables 3.14 to 3.24 explained the details for each functional interface in the application. Each functional shows the connection between scene by scenes in the application.

Table 3.14
Start Page Of Application

| **Title:** START PAGE | | **Page: 1** |
|---|---|---|
| Subtitle: None | Graphics: None | **Audio:** Yes |

Description:

Play Button -> AboutKhatPage

Music Button -> music turn On/Off


**Video:** None Animation: Yes

Table 3.15
Info Khat Page Of Application

| **Title:** ABOUT KHAT PAGE | | **Page:** 2 |
|---|---|---|
| Subtitle: None | Graphics: None | **Audio:** Yes |
| Description:<br>Book button -> HistoryPage<br>Frame button -> KhatTypePage<br>Stationery button -> MaterialPage<br>paper button -> Jomcuba! Page<br>Laptop button -> Teknik menulis page<br>Open book page -> Jom Quiz Page<br>Back button -> Start page |  | |
| | Video: None | Animation: Yes |

Table 3.16
Sejarah Khat Page Of Application

**Title:** HISTORY PAGE **Page:** 3

Subtitle: None Graphics: Yes **Audio:** Yes

Description:

Back button -> AboutKhatPage

Home button -> StartPage

Sound button -> Sound turn on/off


Video: None Animation: Yes

Table 3.17
Khat Type Page Of Application

| **Title:** KHAT TYPE PAGE | | **Page:** 4 |
|---|---|---|
| Subtitle: None | Graphics: None | **Audio:** Yes |

Description:

Nasakh button -> menuNasakhPage

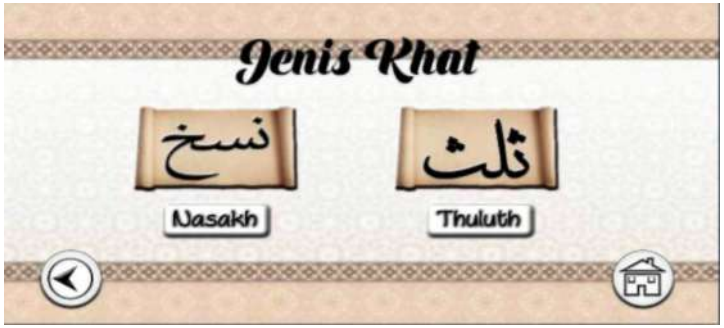
Thuluth button -> menuThuluthPage

NasakhText button -> sound turn on/off

ThuluthText button -> Sound turn on/off

Back button -> AboutKhatPage

Home button -> Start Page




Video: None

Animation: Yes

Table 3.18
Menu Nasakh Page Of Application

| **Title:** MENU NASAKH PAGE | | **Page:** 5 |
|---|---|---|
| Subtitle: None | Graphics: None | **Audio:** None |

Description:

Character button -> tryNasakhPage

Back button -> KhatTypePage

Home button -> start page

Video: None Animation: None

Table 3.19

Menu Thuluth Page Of Application

**Title:** MENU THULUTH PAGE **Page:** 6

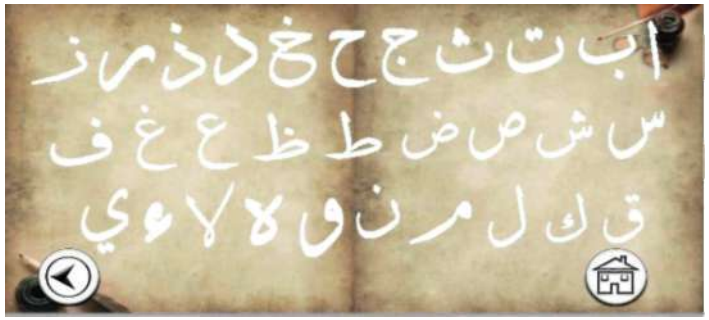
Subtitle: None Graphics: None **Audio:** None

Description:

Character button -> tryThuluthPage

Back button -> KhatTypePage

Home button -> start page



Video: None Animation: None

Table 3.20
Try The Nasakh Page Of The Application

**Title:** TRY NASAKH PAGE

Page: 7

Subtitle: None

Graphics: None

**Audio:** None

Description:

Back button -> menuNasakhPage

Next button -> next character

Home button -> start page

Video: None

Animation: None

Table 3.21
Try The Thuluth Page Of The Application

| Title: TRY Thuluth PAGE | | Page: 8 |
|---|---|---|
| Subtitle: None | Graphics: None | Audio: None |

Description:

Back button -> menuThuluthPage

Next button -> next character

Home button -> start page

^ ^ B L____• — • ir

Video: None

Animation: None

Table 3.22
Mari Cuba! Page Of Application

| **Title:** MARI CUBA! PAGE | | **Page:** 9 |
|---|---|---|
| Subtitle: None | Graphics: Yes | **Audio:** None |

Description:

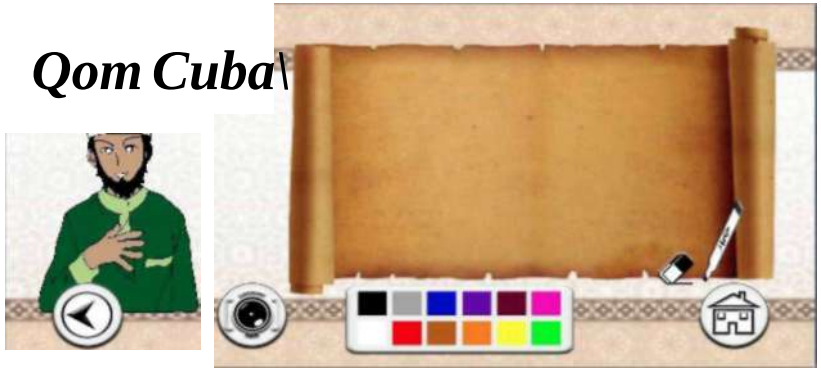
Back button -> AboutKhatPage

Color palette button -> choose various color

Eraser icon -> clear writing

Pencil icon -> writing character

Home button -> Start page




Video: None

Animation: None

Table 3.23
Teknik Menulis Khat Page Of Application

| Title: TEKNIK MENULIS KHAT PAGE | | Page: 10 |
|---|---|---|
| Subtitle: None | Graphics: Yes | Audio: None |


Description:

Back button -> aboutKhatPage

Home button -> start Page

White rectangular -> video

**Video:** Yes Animation: None

Table 3.24

Mari Menguji Minda Page Of The Application

**Title:** MARI MENGUJI MINDA PAGE Page: 11

Subtitle: None Graphics: Yes **Audio:** None

Description:

Mula button -> start quiz

Padam button -> reset quiz

Back button -> aboutKhatPage

Home button -> start Page


**Video:** None Animation: None

Table 3.25

Peralatan Tulisan Khat Page Of Application

**Title:** PERALATAN TULISAN KHAT PAGE Page: 12

Subtitle: None Graphics: Yes **Audio:** Yes

Description:

Kertas button -> sound turn on/off

Pen logam button -> sound turn on/off

Pen resam -> sound turn on/off

Back button -> AboutKhatPage

Home button -> start Page


**VIDEO:** None ANIMATION : None

#### *3.4.1.3 Development Phase*

The third phase of the ADDIE Model is the *Development phase*. This phase transforms the part designed in command to produce a specific creation. In this phase, the interface, design, and code were developed. It involves scripting and recording the prototype content's audio, language, and animation. The prototype implementation will use the information from the requirement planning and user design phases. Every object material used in this application prototype is designed using Adobe Photoshop, Unity, Audacity and Adobe Illustrator software, while the hardware chosen to complete this application uses an ASUS Laptop (S56C), Mobile Devices (Realme C53) and a stylus pen.

Figure 3.7 shows the flow of the process of the development phase. The first process is to gather the collected data. Next, the multimedia elements needed to develop the prototype are checked. Then, design and develop the prototype. Next, check and observe the functionalities of the prototype. Lastly, the prototype is fully functional.

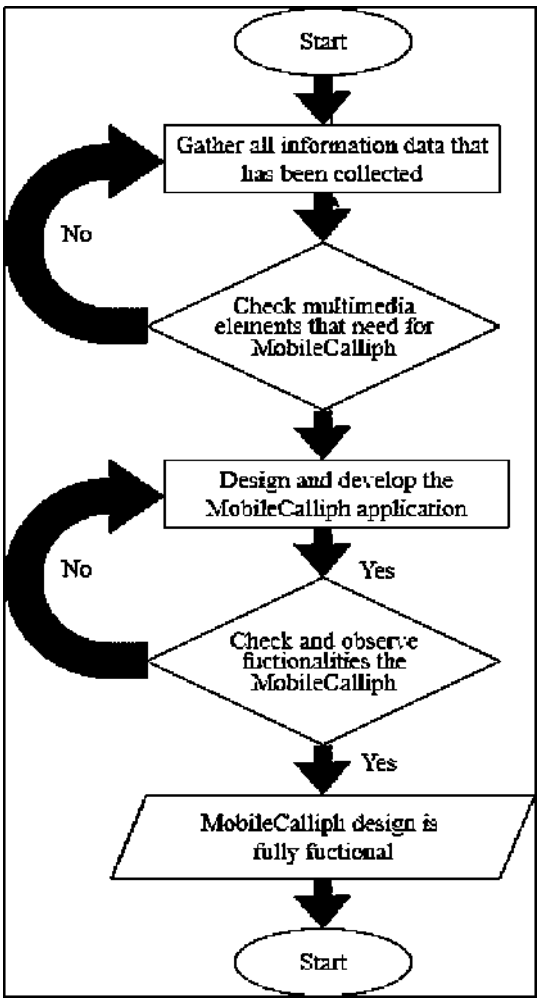



Figure 3.7 Flowchart Of The Process Development Phase

### *3.4.1.4 Implementation Phase*

The next phase is the *Implementation phase*. This phase can only be proceeded after the analysis, design, and development phases are completed. This phase discusses the approach to developing applications, such as website-based, computer-based, classroom, and mobile-based applications.

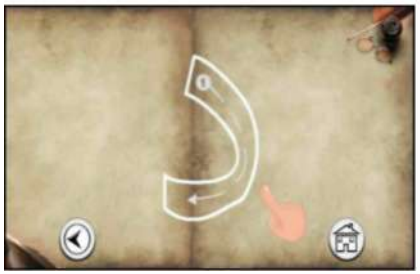
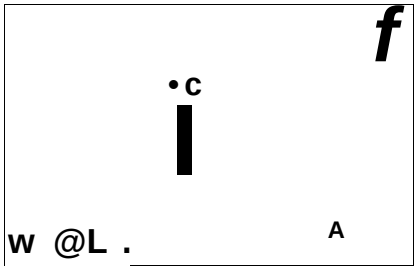
Moreover, the Intelligent Tutoring System (ITS) component and criteria are applied in Islamic Calligraphy handwriting to create interactive and enjoyable calligraphy handwriting applications. This application can be used in a mobile-based approach, where young generations use mobile phones or tablets daily. Table 3.26 below shows the implementation of components and criteria of ITS in the development of the Islamic Calligraphy handwriting application.

Figure 3.8 below shows the flowchart of the implementation phase. Firstly, the

prototype will launch and be distributed to the target user. Next, the target user will be tested with the prototype. Then, the prototype will get the user feedback and the feedback will be analysed to determine whether the target objective is achieved and detect the flaws or imperfections of the applications. Improvement will be made based on the feedback from the user. Then, the final prototype, MobileCalliph, will be launched and the user can use the application.

Table 3.26
Implementation Criteria In The Application

**STUDENT COMPONENT**

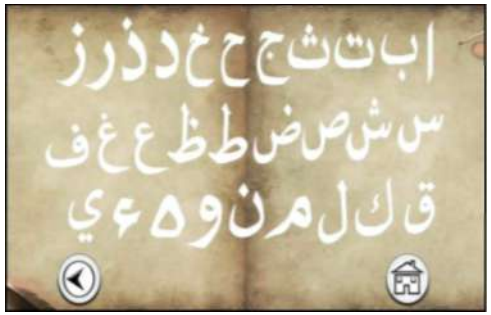
| **Criteria** | **The Implementation** |
|---|---|
| **1.** The learner can trace the calligraphy letter. |   |
| Description | The learner practices calligraphy by following the outline letters and numbering in order. This tracing method helps learners develop the fine motor skills, precision, and muscle memory required to master calligraphy techniques. |
| 2. The tutoring application shows the learner's state. |    |
| Description | Tutoring applications provide insights into a learner's current performance during the learning process. The learner knows whether he/she correctly traced or not. |

3. The learner can manage the difficulty level.

***9enh%htd***

*UasaWn* Thututhj

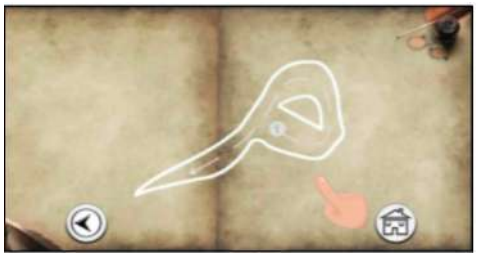
***i*A*A***

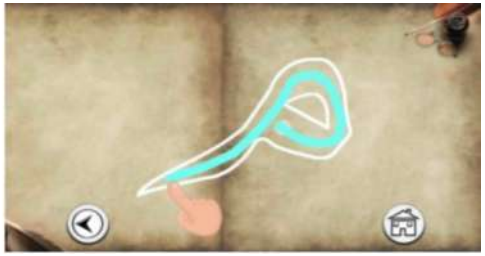


Description

The learner can control what type of khat they want to trace. This is because each letter has a different complexity and challenge. Besides, the tutoring application lets learners choose between tracing complex or straightforward letters. This capability allows learners to match their current skills, knowledge, and comfort level for effective learning.

4. The tutoring application shows the user's performance.

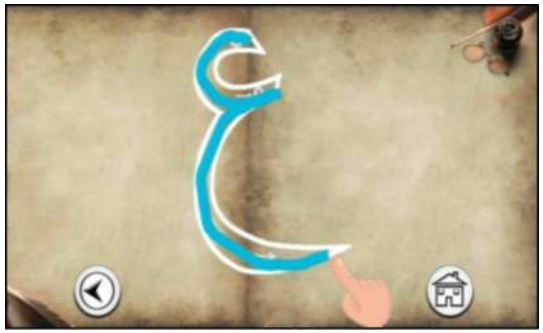




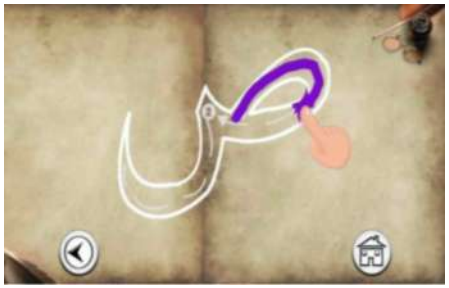
Description

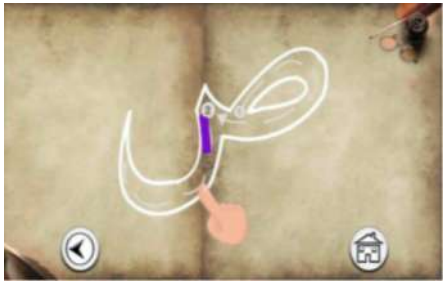
The tutoring application can track learners' progress for improvement based on their interactions with the platform. The learner knows he/she trace well when a congratulatory notification appears.

**TUTORING COMPONENT**

| Criteria | The Implementation |
|---|---|
| **1.** The tutoring application has a tutorial that is easy to follow. |  / rcktiik Wlenulis <Khat .....•.•.••*  |
| Description | An easy-to-follow tutorial guides learners, showing how to grip a pen, followed by guided practice on drawing vertical, horizontal, and curved strokes with video. The tutorial can reduce confusion and enable learners to focus on mastering the subject matter. |
| 2. The tutoring application gives feedback on the user's success or failure. |  ^Av₁v₁v₃yAv₁y₁v^ Tahniah^nd^aya- f v\ ©  |
| Description | The tutoring application can provide feedback on the learner's performance and responses, indicating whether they have completed a task or need to retry. This feedback helps learners understand their progress, correct mistakes, and gain confidence in their skills. |

**3.** The tutoring application will guide the learner in correcting the error.

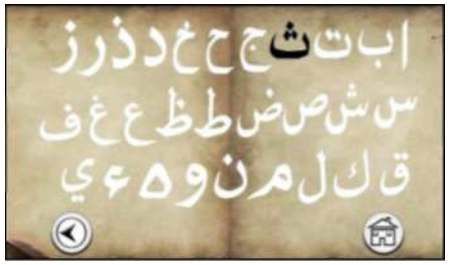




Description

The tutoring application not only identifies mistakes for learners but also helps them understand those errors. This scenario encourages learners to redo the task using the correct stroke with repetition for mastery. Repeated error correction ensures learners fully grasp the concept.

**4.** The tutoring application gives a sense of control over the interaction between calligraphy letters.



OitCC^°'

Description

The tutoring application enables learners to interact with any letter according to their preferences. This task can help learners focus on mastering control over basic letter strokes.

**5.** The tutoring app gives a reward for the correct answer.



Description

The tutoring application provides positive reinforcement, such as a congratulatory message and a clapping sound when learners answer quizzes correctly or complete a tracing exercise. This reward system can encourage consistent effort with a sense of achievement.

**EXPERT COMPONENT**

| Criteria | The Implementation | |
|---|---|---|
| **1.** The tutoring application gives immediate feedback on the user's handwriting. | r<br>/V*-<br>*1m*<br>wvg). | ●<br>ML<br>i<br>9V<br>§ |
| Description | A tutoring application analyzes strokes or angles and provides instant feedback. This feedback helps learners correct mistakes immediately to improve their formation of basic shapes, strokes and handwriting skills. | |
| 2. The tutoring application allows the learner to practice handwriting letters easily. | ^3 *L±M*<br>Oasakh Thututh<br>  | |

Description

The features of a tutoring application make handwriting practice user-friendly and straightforward. This practice encourages engaging experience and skill improvement, especially for learners at different proficiency levels.

3. The tutoring application allows learners to retry the handwritten letter.

Description

The tutoring application enables learners to attempt to handwrite the same letter multiple times. This feature promotes iterative learning, in which learners refine their skills through mistakes, making corrections, and improving their skills each time.

4. The tutoring application responds to letter accuracy.

Description

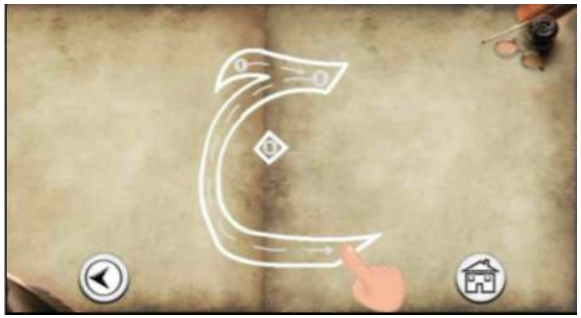
The tutoring application evaluates the precision of a learner's handwritten letter and provides real-time feedback based on how closely it matches predefined standards. It measures stroke placement, letter proportions, and alignment to determine letter accuracy. This helps learners master letter shapes.

**5.** The tutoring application responds to the quality of lines.

Description

The tutoring application evaluates lines and alignment created by the learner during handwriting practice. The application responds to help learners refine their skills and improve their overall handwriting quality. Besides, response to the line quality helps learners develop the precision for high-quality handwriting in Islamic calligraphy.

**INTERACTIVE INTERFACE COMPONENT**

| Criteria | The Implementation |
|---|---|
| **1.** The tutoring application offers self-paced learning. |  |
| Description | The tutoring application allows learners to progress at their own speed. The learners can choose when to start, pause or revisit the module in the application without being bound to a fixed schedule set by the system. This approach accommodates individual learning needs, which makes the learning experience more flexible. |
| **2.** The tutoring app offers an interactive environment for practising. |   |
| Description | The tutoring can engage learners through hands-on and responsive features. This environment encourages learners to practice handwriting skills with an engaging experience rather than a passive or monotonous one. The interactive tracing exercises will help build foundational skills step by step. |

**3.** The tutoring application offers fun learning to deepen their understanding.



Description

The interactive methods in tutoring applications make the learning process enjoyable. When the learner enjoys the learning process, it can boost motivation and encourage active participation in the learning. Learners can experiment with different calligraphy designs through the *Jom Cuba* fun activity.

**4.** The tutoring application provides video and audio auxiliaries in practising calligraphy letters.



Description

The tutoring application integrates multimedia resources such as instructional videos and audio to enhance the calligraphy learning experience. These features help learners visualize and practice the techniques required for calligraphy skill development.

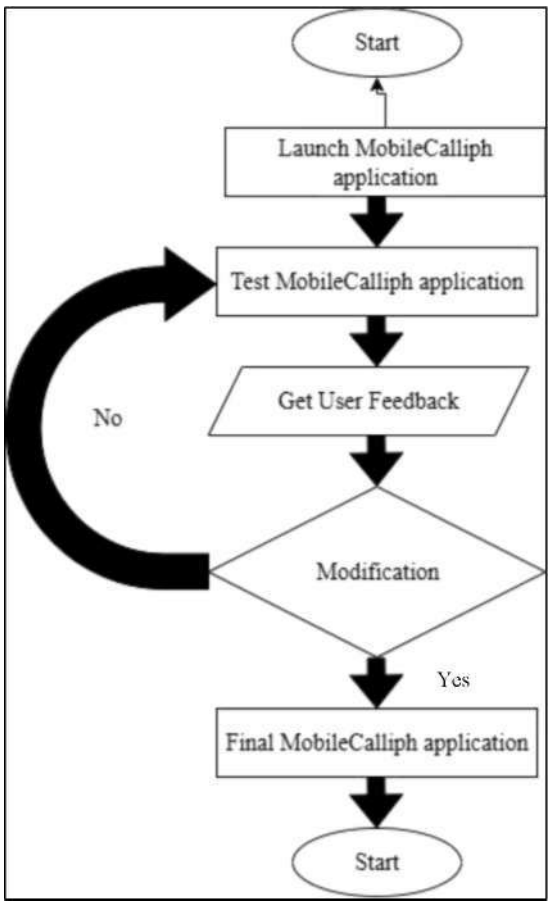


Figure 3.8 Flowchart Of The Implementation Phase

### *3.4.1.5 Evaluation Phase*

The last phase is the *Evaluation Phase*. This phase is important because it evaluates the application by the user. During this evaluation phase, a preliminary study will be carried out for this research study to interview and distribute the questionnaire to the experts for validation. In contrast, the questionnaire will be distributed to the user to evaluate and get feedback about the prototype. The evaluation method will be carried out by using a quantitative approach. The I-HATIC Framework was validated by expert review. The evaluation will use Content Validity. In this study, the target users are the young generation, especially students aged 10 to 12. The questionnaires from the I-HATIC instrument were distributed to the user after testing the prototype.

### 3.4.2 Interactive Evaluation

The I-HATIC Framework research project seeks to evaluate the I-HATIC Framework by utilising an interactive Islamic Calligraphy Handwriting (I-HATIC) application *named MobileCalliph: Learning Calligraphy for Beginners.* This prototype implements I-HATIC components such as the Student Component, Expert Component, Tutoring Component, and Interactive Interface Component, which will be analysed. Participants explore the MobileCalliph application and submit feedback via distributed questionnaires.

#### *3.4.2.1 The Procedures*

In evaluating the interactivity of the MobileCalliph prototype with the implementation of the I-HATIC Framework, several procedures must be followed to ensure a comprehensive and reliable result. Firstly, recruit participants aged 10 to 12 and obtain consent using the consent form. These age categories are under age and need agreement from the consent form to align with ethical standards as stated in the Research Ethics Forms.

Next, all the respondents were briefed and demoed the application before starting the testing. So that the project could run successfully during testing, it took 5 to 7 minutes per person to complete the testing of the application. After they tested the prototype, they were given a set of questionnaires through Google Forms to give feedback. Once the evaluation process is completed, the participants will receive a gift as a token of appreciation for their valuable contribution to the evaluation of the I-HATIC application prototype. The gift expresses gratitude and acknowledges their time and effort in providing the feedback. Figure 3.9 below illustrates the necessary steps for the user's evaluation through the I-HATIC application prototype evaluation process.

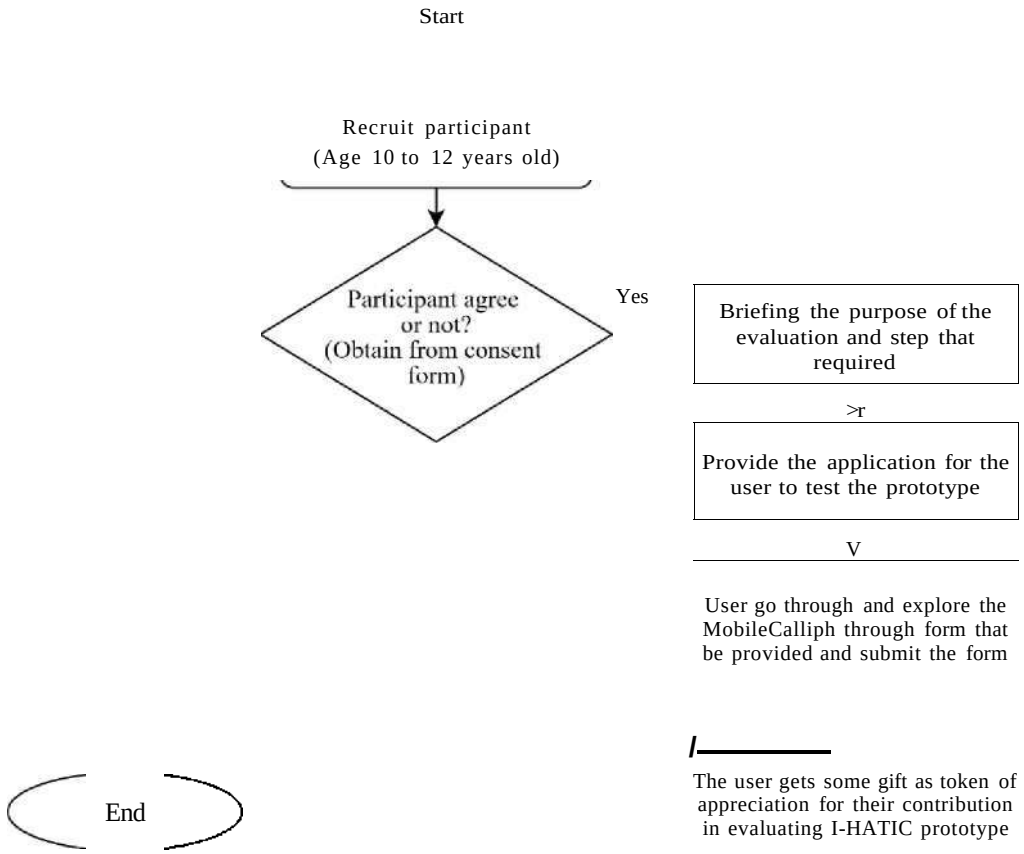



Figure 3.9 The Steps During The Evaluation Process

The evaluation of the I-HATIC Framework within the MobileCalliph prototype application is conducted using the I-HATIC Framework instrument. These questionnaires consist of four components in the I-HATIC Framework: The Student Component, Expert Component, Tutoring Component, and Interactive Interface Component. In order to ensure a smooth evaluation process, Google Forms is utilised to create and distribute the questionnaires to respondents. These tools prove highly effective in simplifying data collection and analysis. Besides, *Google Forms* automatically generates graphs and summarises the analysis by facilitating more straightforward calculation and interpretation of evaluation results. This setting enhances the efficiency of data processing and ensures the accuracy and organized presentation of feedback collected from the respondent.

In the evaluation form, the respondent was first asked to provide demographic information, including their gender, age and whether they have a mobile phone. This initial section helps contextualise the feedback based on the user's background. The

form consists of four sections, each focusing on components in the I-HATIC Framework: *Student Component, Expert Component, Tutoring Component, and Interactive Interface Component.* Each section has four or five questions, depending on the criteria in the I-HATIC Framework. These questions are designed to gather detailed insights into users' experiences and perceptions of each criterion in the framework components. Each question ranged from strongly agree to strongly disagree on a scale. The complete evaluation form can be found in the Appendix section.

#### *3.4.2.2 The Instrument*

The instrument used for the evaluation is based on the I-HATIC Framework instrument. This framework encompasses four components, each consisting of four or five criteria. From these components, 28 items were developed to evaluate the interactivity. The detailed breakdown of these questions, including the components and corresponding items, is presented in Table 3.27 below.

Table 3.27
I-HATIC Framework Instrument

| | **Components** | | **Criteria** |
|---|---|---|---|
| 1 | Student Component | SI | The learner can trace the calligraphy letter. |
| | | S2 | The tutoring application shows the learner's state. |
| | | S3 | The learner can manage the difficulty level |
| | | S4 | The tutoring application shows the user's performance |
| 2 | Tutoring Component | Tl | The tutoring application has a tutorial that is easy to follow |
| | | T2 | The tutoring application gives feedback on the learner's success or failure. |
| | | T3 | |
| | | T4 | The tutoring application will guide the learner in correcting the error |
| | | T5 | The tutoring application gives a sense of control over the interaction between calligraphy letters |
| | | | The tutoring app gives a reward for the correct answer. |

| | | | |
|---|---|---|---|
| 3 | Expert Component | El | The tutoring application gives immediate feedback on the learner's handwriting. |
| | | E2 | The tutoring application allows the learner to practice handwriting letters easily. |
| | | E3 | The tutoring application allows learners to retry the handwritten letter. |
| | | E4 | The tutoring application responds to letter accuracy. |
| | | E5 | The tutoring application responds to the quality of lines. |
| | Interactive Interface Component | 11 | The tutoring application responds to the quality of the learner's handwriting letter. |
| | | 12 | The tutoring app offers an interactive environment for practising. |
| | | 13 | The tutoring application offers fun learning to deepen their |
| | | 14 | understanding |
| | | | The tutoring app provides video and audio auxiliaries in practicing calligraphy letters. |

### 3.4.3 Phase 4: Documentation

The fourth phase is the documentation for this research to prove the i-HATIC Framework in a handwriting tutoring application. This framework will be compiled in the final report to prove this. This framework's main components or features are the Intelligent tutoring system and game features. It proves that the components of gamification and the intelligent tutoring system (ITS) must be developed to make handwriting applications more interactive. It can guide those who want to develop an application based on handwriting learning. Developers can use this framework as a guideline to make an application like a virtual teacher teaching handwriting. Table 3.28 summarises the research methodology used in this study.

Table 3.28
The Summarization Of The Research Methodology

| Phase | Activity | Method of Data Collection and Analysis | Sampling Design | Procedure and technique / experimental setup |
|---|---|---|---|---|
| **Phase 1** Problem Investigation | Comprehensive Literature Review | • The problem was investigated through an extensive literature review.<br>• A comprehensive literature review will be conducted to determine the initial extracted list of existing components in the existing framework. | N/A | Procedure to investigate the problem with an answer to this question:<br>• What is the problem?<br>• Why is it a problem?<br>• Where is the problem occurring?<br>• Who is experiencing the problem?<br>• When is the problem occurring?<br>• How was the problem observed?<br>• How often was the problem observed? |
| | Conduct a preliminary study to interview the experts. | • Interview with the experts. | | The procedure for conducting this preliminary study is to prepare the questions for the experts. |
| **Phase 2** Framework Development and Validation | Extract a list of existing/new components ofthel-HATIC framework | Content Analysis | The component is extracted, and enhancements are made from the existing framework. | • Investigate through an extensive literature review to find the components related to this study.<br>• The components will be extracted from the existing model, framework, or theory related to this study. |

| | | | | |
|---|---|---|---|---|
| | | | | • Combine existing and new components that are related to this study. |
| | Assess experts' reviews regarding the extracted components | Content Validity:<br>• Content Validity Ratio (CVR)<br>• Item Content Validity Index (I-CVI)<br>• Scale Content Validity Index (S-CVI) | • The draft framework will be sent to the research domain's academic experts for validation through a questionnaire.<br>• For this purpose, some experts/professionals who are well-known in their respective fields, especially game design experts and Islamic calligraphy experts, will be contacted to comment on the proposed framework draft.<br>• In light of experts' opinions, necessary amendments will be made to the framework. | • The experts' panel consists of specialised academics and industry professionals.<br>• These experts are in the field of Islamic calligraphy. |
| **Phase 3** Framework Evaluation | Demonstration of the I-HATIC framework in application | • Experimental design<br>• Develop a handwriting mobile application using ADDIE methodology | • The target users are the young generation (10 to 12 years old)<br>• The group of calligraphy students. | The evaluation will be made through the questionnaire to get feedback about this framework in the application. |
| **Phase 4** Documentation | Document all activities in Phase 1, Phase 2, Phase 3 and Phase 4 | [1] Details of reporting | N/A | Each phase was explained thoroughly for reference in future studies. |

## 3.5 Summary

The Interactive Tutoring Handwriting Islamic Calligraphy Conceptual Framework (I-HATIC Framework) contains several phases that need to be completed. The framework starts with investigating the problem that needs to be faced. Next, the framework was constructed by investigating the existing relevant theoretical fundamentals. It enhanced the existing framework while developing the I-HATIC Framework. The research domain's academic experts, including Islamic calligraphy experts, validated it through an expert review process, receiving comments or opinions. After the validation, this framework was evaluated through a prototype application and tested by a group of Islamic calligraphy students and the young generation aged 10 to 12 to evaluate the interactivity while using the handwriting application. Documentation was produced for all the activities that were carried out.

# CHAPTER 4
# RESULTS AND ANALYSIS

## 4.1 Introduction

This chapter discusses the results and the analysis of the overall research study of the I-HATIC Framework. This chapter thoroughly explains the results of this study. This is to ensure that it meets the objective of the study. The evaluation is based on an interactive framework to find the result of expert review and users' use of the application. The analysis has been collected and calculated based on qualitative data. The data are presented as a graph and will be explained more in this chapter.

## 4.2 Findings of Phase 1: Problem Investigation

In this phase, a comprehensive research problem was investigated through an intensive literature review and preliminary study. The literature review systematically analyses a broad range of scholarly articles, journals, and conference proceedings, utilising keywords such as "handwriting application, "tutoring handwriting", "handwriting calligraphy application", and other terms related to the study.

This study aimed to identify the challenges and gaps within the context of tutoring handwriting calligraphy. The findings from this process provided critical insights into the current state of interactive tutoring handwriting calligraphy applications, highlighting key areas requiring further information and development. This phase also facilitated the formulation of essential research components, which include a problem statement, research gaps, research objectives, research questions, the significance of the study, and its limitations. These foundational elements were instrumental in defining the research scope and purpose. Furthermore, a preliminary study was conducted to interview the experts to find the problems and enhancements needed in the new tutoring handwriting framework.

### 4.2.1 Preliminary findings

The expert's selection process was be conducted based on expert experience in Islamic calligraphy. After the selection, a focus group session with the four experts conducted a preliminary study. The primary objective of this study was to find the problems and enhancements to attract the young generations to learn Islamic calligraphy through an application. The findings were systematically recorded, with the answers for each question during focus group sessions. Table 4.1 shows the findings of the preliminary study.

Table 4.1
The Findings Of The Preliminary Study

| Questions | Expert | Answer |
|---|---|---|
| 1. What did you do before/during/after attending the teaching activities? Why did you do so? | Expert 1 | • Before attending the class, 80% of the preparation is needed to tutor the student, which includes preparing the tools and teaching materials.<br>• During class, the tutor must be a presenter or a practical presenter to write Islamic calligraphy during the show.<br>• After class, the tutor needs to access WhatsApp to check and give feedback to follow up.<br>• It can give students exposure or help them know what type of student they are, whether beginner or intermediate-level. |
| | Expert 2 | • Before class, the tutor needs to prepare physically and mentally, and they need to prepare the material items.<br>• The tutor must give examples of Islamic calligraphy and writing techniques to new students during class. They also give some material from an expert calligrapher to motivate them to learn. |
| | Expert 3 | • Before class during the pandemic, the tutor needs to teach the students on social media platforms.<br>• The student and tutor must focus on what needs to be learned or taught during the class.<br>• The tutor needs to give the assessment and follow up through WhatsApp only. |
| | Expert 4 | • The tutor needs to prepare the paper and other materials for the students. |

| | | | |
|---|---|---|---|
| | | | Tutor needs to enhance their writing skills. |
| 2. | When did you realize that limited teachers or trainers teach Islamic calligraphy? | Expert 1 | • Since 1995, a limited number of calligraphers have been tutors<br>• Not confident in teaching Islamic Calligraphy |
| | | Expert 2 | • Mainly a calligraphy tutor in *"Muzium Kesenian."*<br>• Many calligraphy tutors are not exposed to teaching Islamic Calligraphy to the public. |
| | | Expert 3 | • Many experts in calligraphy are afraid to teach calligraphy. |
| | | Expert 4 | • Many experts in writing calligraphy are afraid to expose themselves when teaching calligraphy.<br>• Not interested in teaching calligraphy |
| 3. | How did you and the calligraphy trainer train students to write calligraphy letters smoothly? | Expert 1 | • Need more time to practice.<br>• It requires intensive training, which starts from Nasakh because it is the simplest letter in calligraphy. |
| | | Expert 2 | • We need to practice more and be consistent.<br>• Repeating the writing of a calligraphy letter |
| | | Expert 3 | • Duplicate methods.<br>• Follow up with the student. |
| | | Expert 4 | • Practical method.<br>• The method of duplicating the letter is to write the letter in the application.<br>• The creativity of the tutor in attracting the student to learn Islamic calligraphy |
| 4. | Why is it important to say that calligraphy handwriting needs more practice? | Expert 1 | • It can help one succeed in writing Islamic calligraphy.<br>• It can be mastered in the writing of Islamic calligraphy. |
| | | Expert 2 | • Students can learn the duplicate method, especially the thickness of the letter and the line for each letter.<br>• Can know the shape of each letter. |
| | | Expert 3 | • The student can be an expert in calligraphy. |
| | | Expert 4 | • The student can be creative in writing when learning calligraphy<br>• Can improve knowledge of writing skills. |

| | | | |
|---|---|---|---|
| | Why did you ensure that students always need to listen to the teachers or calligraphy trainers and stay focused during the lectures? | Expert 1 | • The etiquette of seeking knowledge.<br>• Mastering some knowledge<br>• Discipline during the writing of the calligraphy<br>• It is hard to master the technique of writing Islamic calligraphy if one does not focus during class. |
| | | Expert 2 | • Focusing in class is important because writing calligraphy and moving the hand during writing are important. |
| | | Expert 3 | • If not focused, the student does not gain anything during class. |
| | | Expert 4 | • Can know the method of writing<br>• Calligraphy can make the writing more beautiful |
| 6. | Why did you change the strategy to attract students to enjoy learning calligraphy handwriting? | Expert 1 | • Use virtual classes |
| | | Expert 2 | • Use the application to attract people to write and learn Islamic calligraphy. |
| | | Expert 3 | • Change the way of teaching to attract the students, such as using platforms to teach. |
| | | Expert 4 | Use the platforms to teach calligraphy. |
| 7. | If you could think of using a calligraphy handwriting application to support training, which strategy would you maintain? Why? | Expert 1 | The technique corresponds with the lettering of Islamic calligraphy, especially in type. Technique in connecting each letter, which needs the outline to make it easier for students to duplicate |
| | | Expert 2 | • The way to write the letter<br>• Quizzes |
| | | Expert 3 | • Letter match |
| | | Expert 4 | Puzzle<br>quizzes |

## 4.3 Findings of Phase 2: Framework Development and Validation

The Phase 2 framework development covers face validation and content validation findings. Face validity of the instrument was evaluated to provide the measurement and assumptions based on the expert's observation of the study (Allen et al., 2023). It involves the clarity and relevance of the construction of the evaluation.

### 4.3.1 Face Validity findings

Regarding face validity, Oluwatayo, (2012) outlined that the key criteria must be met as reasonable, relevant and clear. As shown in the table above, all the experts unanimously agreed with the first criterion: 'Use of correct and appropriate grammar.' This setting emphasised that the sentences in the I-HATIC framework must be present tense. Additionally, none of the elements within the I-HATIC Framework contains grammatical errors.

Next, under the criterion of'Adjusted use of appropriate language,' both experts agreed that all I-HATIC instruments utilise poor English, ensuring clarity and comprehension before being distributed to the target audience. The expert also confirmed that the I-HATIC questionnaires comply with the 'Use of Correct Spelling criterion', with no typographical errors or confusing sentences requiring further clarification. Moreover, in the criterion of 'Correct sentence structure,' both experts agreed that sentences in the I-HATIC questionnaire are accurate and precise, contributing to the overall professionalism and readability of the instrument.

Furthermore, the experts strongly agreed that all questions in the I-HATIC questionnaires should use 'Appropriate writing size', size 24, and a suitable font. Lastly, when evaluating the content of the I-HATIC instrument, both experts agreed that the material was appropriate and aligned with the tool's intended purpose. In conclusion, both experts achieved a perfect score, with unanimous agreement (seven out of seven) on all criteria for face validity. Additionally, the percentage of agreement recorded 100% for both experts confirms that the I-HATIC instrument has been exceptionally well-designed and fully comprehensible to the intended audience. Table 4.2 shows that the criteria were evaluated based on the results of two experts.

Table 4.2
The Result Of Face Validation

| Evaluation Criteria | Expert 1 | Expert 2 |
|---|---|---|
| *1.* Use of correct and appropriate grammar | **V** | **V** |
| *2.* Adjusted use of appropriate language | ***A*** | ***A*** |
| *3.* Use of correct spelling | ***A*** | ***A*** |
| *4.* Correct sentence structure | ***A*** | ***A*** |
| *5.* Appropriate writing size | ***A*** | ***A*** |
| *6.* Appropriate format | ***A*** | ***A*** |
| *7.* Appropriate content | ***A*** | ***A*** |
| **Total of Agreement** | *in* | *in* |
| **Percentage of Agreement** | **100%** | **100%** |
| **Average percentage of Agreement** | **100%** | **100%** |

### 4.3.2 Content Validity findings

The initial draft of the I-HATIC Framework was sent to the experts for their opinions, suggestions and feedback on all components and the items of the I-HATIC Framework, including the components, operational definitions and criteria. The experts must rate and evaluate the instruments on a four-point rating scale for each item: Relevant and Clarity. The experts need to rate Relevant (1 = Not Relevant, 2 = Elements need some Revision, 3 = Relevant but need some Revision, 4 = Highly Relevant) while for Clarity need to rate (1 = Not Clear, 2 = Item need some Revision, 3 = Clear but need some Revision, 4 = Very Clear) (Roebianto et al., 2023). In this expert validation, 10 experts agreed to participate in validating the I-HATIC Framework instruments.

After the validation, the expert's evaluation was calculated using the formula to ensure the validity of each content. The calculation formula is shown in Table 4.3.

Table 4.3
The Formula For The Calculation

| Item | Formula |
|---|---|
| N | The total number of experts |
| Ne | The total number of agreements in the number of 3 or 4 |
| Content Validity Ratio (CVR) | = (JV«-£)/£) |
| Content Validity Index (CVI) | = (-) |
| Item-Content Validity for Individual Items (I-CVI) | = (number of experts providing a rating of 3 or 4) / (number of experts) |
| Scale-level content validity index based on the average method (S-CWAv) | = (Sum of I-CVI scores) / (number of Items) |
| Probability of chance agreement (Pc) | = [ "' J*0_5" |
| Kappa(K) | (I-CVI-Pc)/(I-Pc) |

Source: (Zain et al., 2022)

All relevant data supporting the prototype content were gathered in the Requirement Planning phase. Numerous resources are expended to collect the information, such as interviews, surveys, online journals, articles and e-books. These methods are used to find information and solutions for the project objectives, problem statement, scope, and literature review. The strengths and weaknesses of the project will be pointed out to improve and produce a better Islamic Calligraphy Handwriting application. Lastly, all the collected information will be adequately documented for the following development process.

The Lawshe Table is widely used in calculating analysis, developed by S.H. Lawshe in 1975. This method employs the Content Validity Ratio (CVR) calculation to determine the essentials of the item to be maintained in the instrument, evaluated by the experts (Masuwai et al., 2024). The experts assess each item by categorising it as "essential", "useful but not essential" or "not necessary". The formula of CVR was invented to calculate each item:

$$CVR = \{Ne--)/\{-) \qquad n \cdot 0)$$

In this case, Ne is the number of people who give a rating of 3 or 4, and N is the total number of experts. The resulting value of CVR, when fewer than half of the results say "essential the CVR is negative, while half the results say "essential" and half do not, is zero and if all the results say "essential", the CVR is computed to 1.0.

The Lawshe Table provide the critical CVR values that vary based on the number of experts involved. For an item to be valid, the CVR value must meet or exceed the threshold critical value corresponding to the number of experts. For instance, if the minimum value of experts is 5, the CVR value is 0.99, while if the number of experts is 10, the CVR value is 0.62. The items of CVR values that meet the minimum values will be retained, while those that do not meet the requirement value will be pointed out to be removed as they lack sufficient relevance to construct the final form of the test (LAWSHE, 1975).

This method is systematically practical in ensuring the inclusion of only the most relevant and essential items in the instrument. By focusing on content validity, the Lawshe Table enhance the quality, reliability and applicability of the measurement of the I-HATIC Framework and instruments. Table 4.4 shows Lawshe's Table, which has been calculated in the I-HATIC instrument validity.

Table 4.4
The Calculation Of The Minimum Value Of CVR

| **Number of experts** | **5** | **6** | 7 | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **20** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Min Value** | 0.99 | 0.99 | 0.99 | 0.75 | 0.78 | 0.62 | 0.59 | 0.56 | 0.54 | 0.51 | 0.49 | 0.42 |

Source: (LAWSHE, 1975)

#### *4.3.2.1 Component Relevancy*

Relevance is a critical component of content validity, ensuring that each item is measured accurately, corresponding to the proposed objective, representing the construct targeted for specific evaluation and determining that the components can be successful (Mohamad Tarmizi & Janan, 2022). In the process of I-HATIC instrument development, content validity is essential and closely linked to reliability. Establishing the content validity involves evaluating whether the items are directly relevant to and

underlying the concept being measured. Ensuring the relevance of content validity provides a reliable and meaningful result of the I-HATIC instruments. Table 4.5 shows the components of the I-HATIC Framework presented as code for the following findings.

Table 4.5
The Code Is Represented In The I-HATIC Components

| Code | Components |
|---|---|
| **S** | **Student** |
| **T** | **Tutoring** |
| **E** | **Expert** |
| **I** | **Interactive Interface** |

Table 4.6 presents the findings of the content validity of each component in the I-HATIC framework. According to the expert panel, items S, T, E, and I show excellent validity and are highly relevant, with I-CVI values ranging from 0.90 to 1.00. The S-CVI value for each component in this framework is 0.93. Moreover, all experts agreed that S exhibits excellent validity and is highly relevant, achieving 1.00, while T, E, and I also have strong validity, which is 0.9. Furthermore, all the items of the components framework were retained based on all the expert evaluations and the score values.

Table 4.6
I-Hatic Component Relevancy

| Code | N | Ne | CVR | I-CVI | Pc | Kappa | Evaluation |
|---|---|---|---|---|---|---|---|
| **S** | **10** | **10** | **1.0** | **1.0** | **0.5** | 1.000 | **excellent** |
| **T** | **10** | **9** | **0.8** | **0.9** | **5.0** | 1.025 | **excellent** |
| **E** | **10** | **9** | **0.8** | **0.9** | **5.0** | 1.025 | **excellent** |
| **I** | **10** | **9** | **0.8** | **0.9** | **5.0** | 1.025 | **excellent** |
| | | | | | | **S-CVI/ave** | **0.925** |

***Content Validity Ratio (CVR)= (Ne - -)/(-)***

***Content validity for the individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 /number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity=I-CVI>0.78 andKappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and*

*Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

The items of the components in the I-HATIC instruments are being evaluated through the relevancy and clarity of each item under different components. All the items with the code are tabulated in Table 4.7.

Table 4.7
Code For The Items In Components I-HATIC

| Components | Code |
|---|---|
| **Student** | SI - The learner can trace the calligraphy letter |
| | S2 - The tutoring application shows the learner's state |
| | S3 - The learner can manage the difficulty level |
| | S4 - The tutoring application shows the user's performance |
| **Tutoring** | Tl - The tutoring application has a tutorial that is easy to follow |
| | T2 - The tutoring application gives feedback on the learner's success or failure |
| | T3 - The tutoring application will guide the learner in correcting the error |
| | T4 - The tutoring application gives a sense of control over the interaction between calligraphy letters |
| | T5 - The tutoring app gives a reward for the correct answer. |
| Expert | El - The tutoring application gives immediate feedback on the learner's handwriting |
| | E2 - The tutoring application allows the learner to practice handwriting letters easily |
| | E3 - The tutoring application allows learners to retry the handwritten letter |
| | E4 - The tutoring application responds to letter accuracy |
| | E5 - The tutoring application responds to the quality of lines |
| **Interactive Interface** | II - The tutoring application responds to the quality of the learner's handwriting letter |
| | 12 - The tutoring app offers an interactive environment for practising |
| | 13 - The tutoring application offers fun learning to deepen their understanding |
| | 14 - The tutoring app provides video and audio auxiliaries in practicing calligraphy letters |

#### *4.3.2.2 Item Relevancy*

**Student Component**

Table 4.8 below presents the findings of the item of the student component in the i-HATIC framework. According to the expert panel, items SI, S2, S3, and S4 show excellent validity and are highly relevant, with I-CVI values of 1.00. The S-CVI value for each component in this framework is 1.00. Moreover, all experts agreed that SI, S2, S3, and S4 exhibit excellent validity and are highly relevant, achieving 1.00. Furthermore, all the items of the Student components were retained based on all the expert evaluations and the score values.

Table 4.8
Relevancy Of The Item In The Student Component

| Item | ***N*** | ***Ne*** | ***CVR*** | ***I-CVI*** | ***Pc*** | ***Kappa*** | ***Evaluation*** |
|---|---|---|---|---|---|---|---|
| SI | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| S2 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| S3 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| S4 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| | | | | | | *S-CVI/ave* | 1.00 |

***Content Validity Ratio (CVR)= ( Ne-nZ)/(nZ)***
***Content validity for the individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 / number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity =I-CVI>0.78 and Kappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

**Tutoring Component**

All items in the Tutoring component are considered highly relevant, demonstrating excellent validity with I-CVI and Kappa values exceeding 0.90, while the I-CVI reach the highest value of 1.00. The S-CVI for the Tutoring Component stands at 0.94, reflecting outstanding content validity. The CVR values for the five items

were also deemed highly relevant, ranging between 0.8 and 1.0. Overall, the items in the Tutoring component are considered relevant and require no elimination. Table 4.9 shows the findings of the relevance of the item in the tutoring component.

Table 4.9
Relevancy Of The Item In The Tutoring Component

| Item | *N* | *Ne* | *CVR* | *I-CVI* | *Pc* | *Kappa* | *Evaluation* |
|---|---|---|---|---|---|---|---|
| T1 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| T2 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| T3 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| T4 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| T5 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| | | | | | | *S-CVI/ave* | 0.94 |

***Content Validity Ratio (CVR)= ( Ne-nZ)/(nZ)***
***Content validity for individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 / number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity =I-CVI>0.78 and Kappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

**Expert Component**

All items in the Expert component are considered highly relevant, demonstrating excellent validity with I-CVI and Kappa values exceeding 0.90, while the I-CVI reach the highest value of 1.00. The S-CVI for the Tutoring Component stands at 0.96, reflecting outstanding content validity. The CVR values for the five items were also deemed highly relevant, ranging between 0.8 and 1.0. Overall, the items in the Tutoring component are considered relevant and require no elimination. Table 4.10 shows the findings of the relevancy of the item in the Expert component.

Table 4.10
Relevancy Of The Item In The Expert Component

| **Code** | *N* | *Ne* | *CVR* | *I-CVI* | *Pc* | *Kappa* | *Evaluation* |
|---|---|---|---|---|---|---|---|
| El | 10 | 10 | L0 | L0 | 05 | 1 | excellent |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| E2 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| E3 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| E4 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| E5 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| | | | | | | *S-CVI/ave* | 0.96 |

***Content Validity Ratio (CVR)= ( Ne-nZ)/(nZ)***
***Content validity for individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 / number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity=I-CVI>0.78 andKappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

## Interactive Interface Components

According to Table 4.11 below, all the items in the Interactive component were rated as highly relevant, indicating excellent validity. The I-CVI values for each item, II, 13, and 14, received perfect scores of 1.0. While 12 received 0.9. Moreover, all experts agreed on these items' relevance, each achieving a Kappa value exceeding 0.9. The S-CVI values receive 0.975, which shows a perfect result and is evaluated as an excellent item.

Table 4.11
Relevancy Of The Item In The Interactive Interface Component

| Code | ***N*** | ***Ne*** | ***CVR*** | ***I-CVI*** | ***Pc*** | ***Kappa*** | ***Evaluation*** |
|---|---|---|---|---|---|---|---|
| 11 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| 12 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| 13 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| 14 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| | | | | | | *S-CVI/ave* | 0.975 |

***Content Validity Ratio (CVR)= ( Ne-nZ)/(nZ)***
***Content validity for individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 / number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity=I-CVI>0.78 andKappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

#### *4.3.2.3 Item Clarity*

**Student Component**

According to Table 4.12 below, all the items in the Interactive component were rated as highly relevant, indicating excellent validity. The I-CVI values for all items, from SI to S4, received perfect scores of 1.0. Moreover, all experts agreed on these items' relevance, each achieving a Kappa value exceeding 1.0. The S-CVI values receive a perfect score of 1.0, which shows a perfect result and is evaluated as an excellent item, with no elimination needed.

Table 4.12
Clarity Of The Item In The Student Component

| Code | ***N*** | ***Ne*** | ***CVR*** | ***I-CVI*** | ***Pc*** | ***Kappa*** | ***Evaluation*** |
|---|---|---|---|---|---|---|---|
| SI | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| S2 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| S3 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| S4 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| | | | | | | *S-CVI/ave* | 1.00 |

***Content Validity Ratio (CVR)= ( Ne-nZ)/(nZ)***
***Content validity for individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 / number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity =I-CVI>0.78 and Kappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

**Tutoring Component**

All items in the Tutoring component are considered highly relevant, demonstrating excellent validity with I-CVI and Kappa values exceeding 0.90, while the I-CVI reach the highest value of 1.0. The S-CVI for the Tutoring Component stands at 0.94, reflecting outstanding content validity. The CVR values for the five items were also highly relevant, ranging between 0.8 and 1.0. Overall, the items in the Tutoring

component are considered relevant and require no elimination. Table 4.13 shows the findings of Clarity in the Tutoring component.

Table 4.13
Clarity Of The Item In The Tutoring Component

| Code | *N* | *Ne* | *CVR* | *I-CVI* | *Pc* | *Kappa* | *Evaluation* |
|---|---|---|---|---|---|---|---|
| T1 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| T2 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| T3 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| T4 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| T5 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| | | | | | | *S-CVI/ave* | 0.94 |

***Content Validity Ratio (CVR)= ( Ne-nZ)/(nZ)***
***Content validity for individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 / number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity =I-CVI>0.78 and Kappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

**Expert Component**

Based on Table 4.14, all items in the Expert component were rated highly relevant, with I-CVI values exceeding 0.90 for items E1 to E5. The experts unanimously agreed that items E1, E2, and E3 demonstrated exceptional relevance, each receiving a perfect Kappa value 1.00. The S-CVI/Av for the Expert component also indicated excellent content validity, with a perfect score of 0.96. In summary, the items in the Expert component are considered highly relevant and require no revisions.

Table 4.14
Clarity Of The Item In The Expert Component

| Code | *N* | *Ne* | *CVR* | *I-CVI* | *Pc* | *Kappa* | *Evaluation* |
|---|---|---|---|---|---|---|---|
| E1 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| E2 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| E3 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| E4 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| E5 | 10 | 9 | 0.8 | 0.9 | 5.0 | 1.025 | excellent |
| | | | | | | *S-CVI/ave* | 096 |

***Content Validity Ratio (CVR)= ( Ne~n2)/(n2)***
***Content validity for individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 / number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity=I-CVI>0.78 andKappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

## Interactive Interface Component

Based on Table 4.15, all items in the Expert component were rated highly relevant, with I-CVI values of 1.0 for items II to 14. The experts unanimously agreed that all items from II to 14 demonstrated exceptional relevance, each receiving a perfect Kappa value of 1.00. The S-CVI/Av for the Interactive component also indicated excellent content validity, with a perfect score of 1.0. In summary, the items in the Interactive component are considered highly relevant and require no revisions.

Table 4.15
Clarity Of The Item In The Interactive Component

| Code | *N* | *Ne* | ***CVR*** | ***I-CVI*** | ***Pc*** | ***Kappa*** | ***Evaluation*** |
|---|---|---|---|---|---|---|---|
| 11 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| 12 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| 13 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| 14 | 10 | 10 | 1.0 | 1.0 | 0.5 | 1 | excellent |
| | | | | | | *S-CVI/ave* | 1 |

***Content Validity Ratio (CVR)= ( Ne-nZ)/(nZ)***
***Content validity for individual item (I-CVI)*** *= number of experts providing a rating of 3 or 4 / number of experts* ***Probability of chance occurrence (PC) = [N\ \(N-A)\]*0.5N***
***Kappa (K)*** *= (I-CVI-Pc)/ (I-Pc)*
***Evaluation criteria for the level of content validity: the*** *relationship between I-CVI and Kappa; excellent validity=I-CVI>0.78 andKappa>0.74 (****); good validity=I-CVI<0.78 and >0.60 and Kappa < 0.74 (***); fair validity = I-CVI <0.6 and >0.40 and Kappa <0.59 (**); and poor validity= I-CVK0.4 and Kappa <0.40 (*)*

#### *4.3.2.4 Expert Recommendations and Suggestions*

In the open-questions section, several experts provide valuable recommendations, suggestions and improvements to enhance the I-HATIC Framework instrument. These insights are intended to make the instrument more acceptable and practical to beginners, especially young generations practising Islamic calligraphy.

Expert 3 feedback "Tutoring Component" with suggestion: *"Perhapsyou could change the phrases 'success' or 'failure.' Suggestions could include 'accurate strokes,' 'improvement in line quality,' or 'correct styles."* Experts suggest examining the phrases in more detail to understand the requirements in the I-HATIC framework better.

Next, Expert 4 suggests under "Student Component": *"The student component should be separated based upon the type of calligraphy writing they selected. The exercises also should be by stages to allow the enhancement of writing, such as (1) basic phase - single particle (huruf tunggal) (2) word (kalimah) (3) phrases (frasa) ".* The expert is concerned that the writing skill needs stages to give users learn step-by-step the letter of Islamic calligraphy in more details. Moreover, expert 4 also suggests under "Interactive Interface Component" that " *Videos of experts showing how to write the same words as written by the student should be available".* It can give users more details to help them understand how to write Islamic calligraphy skillfully.

Lastly, expert 6 commented under "Interactive Interface Component": " / *think in this part, audio is another missing element that should be put as a medium"* The expert suggests that the audio needs to be added to items of the I-HATIC framework. It can be used as a medium for interaction between the user and the application.

Based on overall feedback from the experts, the majority provided positive comments. It offered valuable suggestions and recommendations for enhancing user engagement by applying handwriting Islamic Calligraphy components in the I-HATIC framework.

Table 4.16
The Final Result Of The Instrument Of The I-HATIC

| Component | Instrument Before | Instrument After |
|---|---|---|
| Student | • I can trace the calligraphy letter. | The learner can trace the calligraphy letter. |
| | • The tutoring apps show the user's score. | The tutoring application shows the learner's state. |
| | • I can choose the difficulty level. | The learner can manage the difficulty level. |
| | • The tutoring apps show the user's performance. | The tutoring application shows the user's performance. |
| Tutoring | • The tutoring app has a tutorial that is easy to follow. | The tutoring application has a tutorial that is easy to follow. |
| | • The tutoring app gives feedback on the user's success or failure. | The tutoring application gives feedback on the user's success or failure. |
| | • I will be guided in conecting the enor. | The tutoring application will guide the learner in conecting the enor. |
| | • The tutoring app gives a sense of control over the interaction between calligraphy letters. | The tutoring application gives a sense of control over the interaction between calligraphy letters. |
| | • The tutoring app offers a reward for the conect answer. | The tutoring app gives a reward for the conect answer |
| Expert | • The tutoring app gives feedback on the user's writing. | The tutoring application gives immediate feedback on the user's handwriting. |
| | • The tutoring app allows the user to practice handwriting letters. | The tutoring application allows the learner to practice handwriting letters easily. |

| | | |
|---|---|---|
| **Interactive** | I can retry the handwritten letter. | The tutoring application allows learners to retry the handwritten letter. |
| | The tutoring app response to letter accuracy. | The tutoring application responds to letter accuracy. |
| | The tutoring app responds to a line quality. | The tutoring application responds to the quality of lines. |
| | The tutoring app offers interaction based on user preference. | The tutoring application offers interaction based on user preference |
| | The tutoring app offers easy to practice environment. | The tutoring app offers an interactive environment for practising |
| | The tutoring app offers fun learning | The tutoring application offers fun learning to deepen their understanding. |
| | The tutoring app provides video and audio auxiliaries in practicing calligraphy letters. | The tutoring app provides video and audio auxiliaries in practicing calligraphy letters. |

## 4.4 Findings of Phase 3: Framework Evaluation

### 4.4.1 Prototype Demonstration Findings

Table 4.17 shows the respondents' demographics, with the majority being female, 16 out of 30 respondents (53.3%), and *46.1%* male. Regarding their ages, most of the respondents (100%) are between the ages of 12.

The respondents will also be asked whether they have mobile phones to attract them to learn Islamic calligraphy handwriting by using the application. The response shows that 26 out of 30 respondents (86.7%) have mobile phones. For the details of all respondents' demographics, please refer to Table 4.17 below.

Table 4.17
User Demographics

| Questions | Range | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Gender** | Male | **14** | **53.3** |
| | Female | **16** | **46.7** |
| **Age** | 12 years **old** | **30** | **100** |
| **I have a mobile phone.** | Yes | **26** | **86.7** |
| | No | **4** | **13.3** |

#### *4.4.1.1 Findings on Student Component*

Specifically, 47% of respondents chose Agree while 40% chose Strongly Agree in the criteria of 'Learner can trace a calligraphy letter' during the testing of the prototype. This finding shows that most respondents can trace the calligraphy while testing the application prototype. Additionally, 47% of respondents chose Strongly Agree in the criteria 'The tutoring application shows the learner state'. This means the learner can know their ability after writing Islamic calligraphy using the application prototype.

Next, in the criteria 'The learner can manage the difficulty level', the result shows 33%) of respondents chose Neutral and Strongly Agree. It means that some

respondents are unsure of the level of handwriting letters, which can give them satisfaction in challenging themselves while writing Islamic calligraphy letters. However, respondents who chose Strongly Agree found that different letters in Islamic calligraphy are challenging to achieve better and more beautiful handwriting.

Lastly, the majority of respondents, 40%, Strongly Agree and Agree, 'The tutoring application shows the user's performance'. The application shows the respondent their result after writing the calligraphy letter. They can look into their result after tracing the calligraphy letter and try to write the calligraphy after knowing their results.

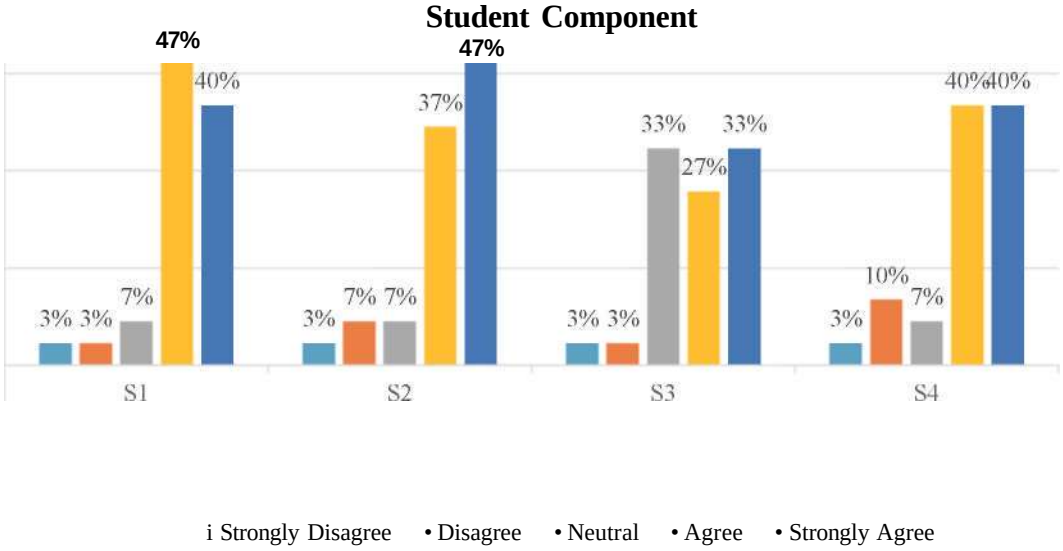



Figure 4.1 The Of Student Component Findings

Table 4.18
Student Component Through Prototype's Findings

| Code | SD | D | N | A | SA | Mean | Std. Dev |
|---|---|---|---|---|---|---|---|
| SI | 1 (3%) | 1 (3%) | 2 (7%) | 14 (47%) | 12 (40%) | 4.17 | 0.95 |
| S2 | 1 (3%) | 2 (7%) | 2 (7%) | 11 (37%) | 14 (47%) | 3.83 | 1.05 |
| S3 | 1 (3%) | 1 (3%) | 10 (33%) | 8 (27%) | 10 (33%) | 4.17 | 1.05 |
| S4 | 1 (3%) | 3 (10%) | 2 (7%) | 12 (40%) | 12 (40%) | 4.03 | 1.09 |
| | | | Total Mean | | | 4.05 | |

#### *4.4.1.2 Findings on Tutoring Component*

The evaluation result in the Tutoring Component shows that the majority of respondents, 70%, Strongly Agree with the criterion 'The tutoring application has a tutorial that is easy to follow'. This result is because the I-HATIC application prototype has clear and helpful guidelines for the user to follow while writing Islamic calligraphy. Next, the respondents agreed in 40%, while 27% strongly agreed that this application prototype gives direct feedback on success or failure after they write the calligraphy. Furthermore, from the direct and clear feedback given by the application, 43% of respondents strongly agree that this application also provides good guidance in correcting errors while writing calligraphy.

Moreover, respondents mostly agreed during prototype testing (53%), and 37% strongly agreed. This application gives a good sense of control in the interaction between calligraphy letters. The respondents have smooth calligraphy writing skills, using a stylus pen and writing letters on mobile phones. Lastly, 50% and 30% of respondents agree and Strongly Disagree that the tutoring application gives a reward for the correct answer. It can give users the enjoyment of retrying until they get better handwriting in Islamic calligraphy to get a reward.

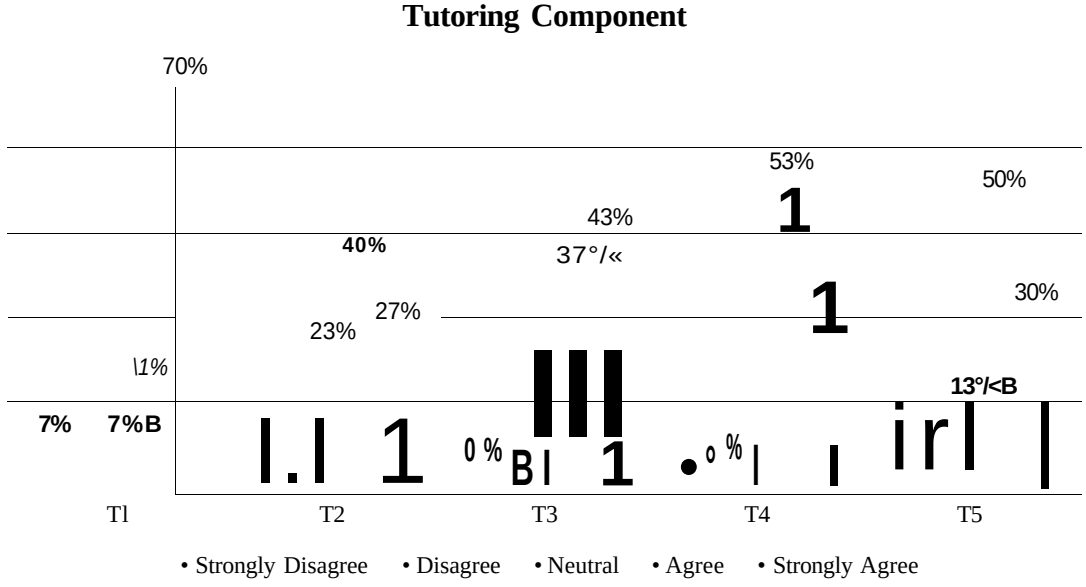



Figure 4.2 The Graph Of Tutoring Component Findings

Table 4.19
Tutoring Component Through Prototype's Findings

| Code | SD | D | N | A | SA | Mean | Std. Dev |
|---|---|---|---|---|---|---|---|
| Tl | 2 (7%) | 0 | 2 (7%) | 5 (17%) | 21 (70%) | 4^43 | 1.10 |
| T2 | 2 (7%) | 1 (3%) | 7 (23%) | 12 (40%) | 8 (27%) | 3.77 | 1.10 |
| T3 | 0 | 1 (3%) | 5 (17%) | 11(37%) | 13 (43%) | 4.20 | 0.85 |
| T4 | 1 (3%) | 0 | 2 (7%) | 16 (53%) | 11 (37%) | 4.20 | 0.85 |
| T5 | 2 (7%) | 0 | 4 (13%) | 15 (50%) | 9 (30%) | 3.97 | 1.03 |
| | | | Total Mean | | | 4.15 | |

### *4.4.1.3 Findings on Expert Component*

Next, in Expert Components, 47% of the respondents Strongly Agree that tutoring applications give immediate feedback after writing the calligraphy. It can give immediate results, whether they fail or succeed in writing calligraphy. Moreover, based on the graph, 63% of respondents Strongly Agree that this tutoring application allows them to practice handwriting Islamic Calligraphy easily and use it everywhere. In this prototype, 60% of the respondents strongly agree that they can retry the handwritten letter a million times without worrying about the cost or time needed to attend classes.

The graph shows Agree and Strongly Agree to give the same result with 33% in the criteria 'The tutoring application responds to letter accuracy, while for the criteria 'The tutoring application responds to the quality of lines,' mostly Agree in bringing 40% of respondents, while 33% Strongly Agree. These two criteria show that during the respondent's handwriting of the calligraphy letter, the system application gives a quick response if they are not writing smoothly or do not follow the guidelines given in the calligraphy letter.

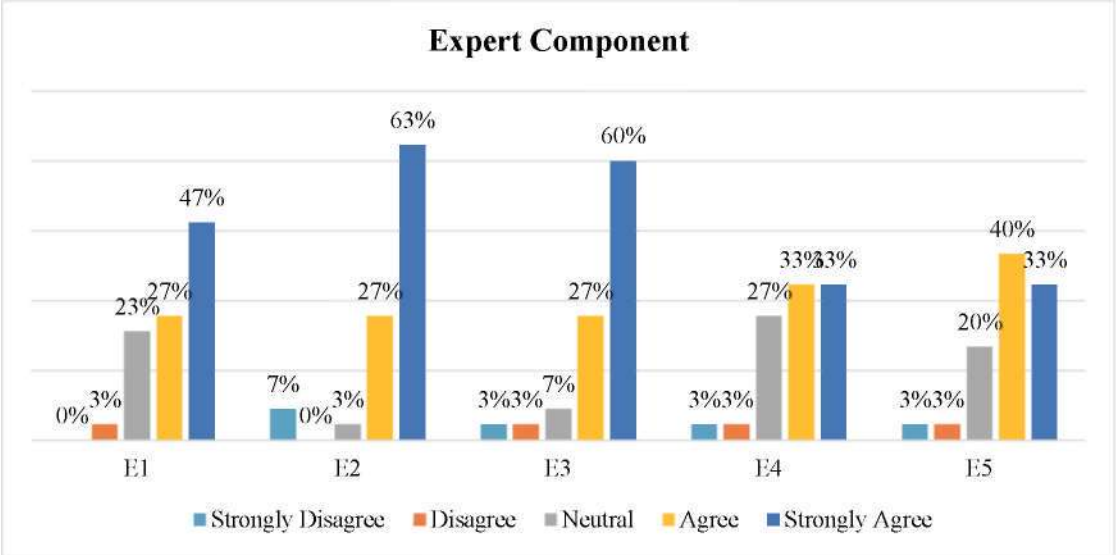



Figure 4.3 The Graph Of Expert Component Findings

Table 4.20
Expert Component Through Prototype's Findings

| Code | SD | D | N | A | SA | Mean | Std. Dev |
|---|---|---|---|---|---|---|---|
| E1 | 0 | 2 (7%) | 7 (23%) | 8 (27%) | 14 (47%) | 407 | 0.91 |
| E2 | 2 (7%) | 0 | 1 (3%) | 8 (27%) | 19 (63%) | 4.40 | 1.07 |
| E3 | 1 (3%) | 1 (3%) | 2 (7%) | 8 (27%) | 18 (60%) | 4.37 | 1.00 |
| E4 | 1 (3%) | 1 (3%) | 8 (27%) | 10 (33%) | 10 (33%) | 3.90 | 1.03 |
| E5 | 1 (3%) | 1 (3%) | 6 (20%) | 12 (40%) | 10 (33%) | 3.97 | 1.00 |
| | | | Total Mean | | | 4.162 | |

### *4.4.1.4 Findings on Interactive Interface Component*

In the Interactive Interface component findings, it can be seen that 50% of respondents agree that they can give an immediate response to the quality of their handwritten letter. Only 3% of respondents Strongly Disagree with this criterion. Next, 43%) of respondents Strongly Agree with the criteria that the tutoring application offers an interactive environment for them to practice Islamic calligraphy. They can enjoy

practising handwriting, and the interface suits them for practising handwriting.

Moreover, the graph shows 63% Strongly Agree while only 3% Strongly Disagree with the criteria 'Tutoring Application offers fun learning to deepen their understanding'. This result means that this prototype gives them fun and improves their knowledge of calligraphy and handwriting. Furthermore, most respondents (50%) strongly agree that tutoring applications provide video and audio auxiliaries in practicing calligraphy letters. They can get detailed steps to create beautiful and proper Islamic calligraphy.

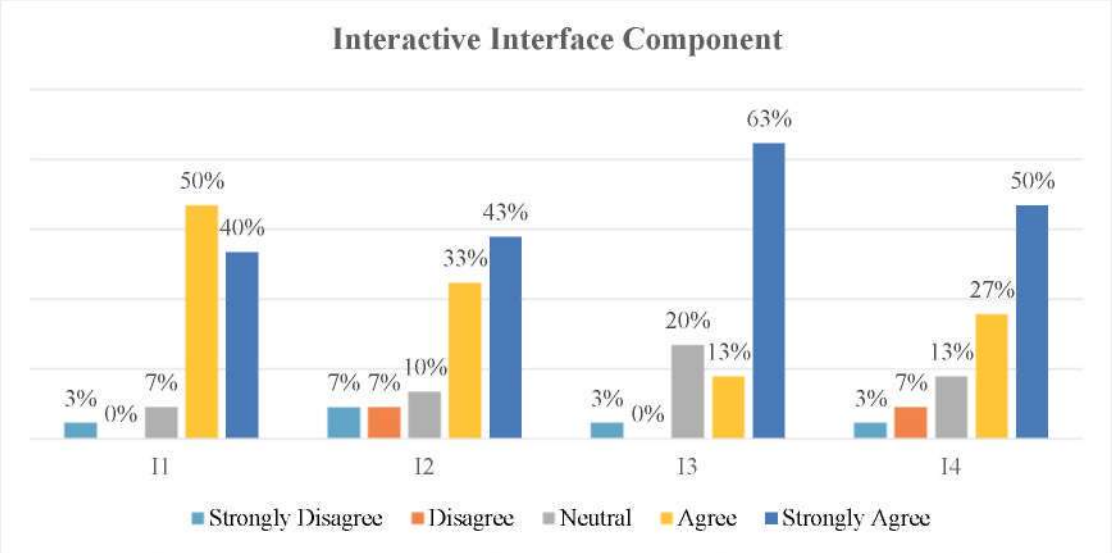



Figure 4.4 The Graph Of Interactive Interface Component Findings

Table 4.21
Interactive Interface Component Through Prototype's Findings

| Code | SD | D | N | A | SA | Mean | Std. Dev |
|---|---|---|---|---|---|---|---|
| 11 | 1 (3%) | 0 | 2 (7%) | 15 (50%) | 12 (40%) | 4.23 | 0.86 |
| 12 | 2 (7%) | 2 (7%) | 3 (10%) | 10 (33%) | 13 (43%) | 4.00 | 1.20 |
| 13 | 1 (3%) | 0 | 6 (20%) | 4 (13%) | 10 (63%) | 4.33 | 1.03 |
| 14 | 1 (3%) | 2 (7%) | 4 (13%) | 8 (27%) | 15 (50%) | 4.13 | 1.11 |
| Total Mean | | | | | | 4.17 | |

### 4.4.2 Summary of Prototype Evaluation

Table shows the result of total mean for each component in the I-HATIC Framework in the application prototype, calculated from the average scores of each criterion within each component. These averages were computed into a total mean average to identify the overall outcome of the evaluation prototype based on the I-HATIC Framework.

According to the table, the highest score among the four (4) components of the I-HATIC Framework is the *"Interactive Interface Component'*, with a mean score of 4.173 with the percentage is 83.46%. This result is closely followed by the *"Expert Component'* with a score of 4.162 and the percentage is 83.24%), the "Tutoring Component" with a score of 4.15 while the percentage is 83%> and lastly, the "Student Component" with a mean score of 4.05 with the percentage is 81%>.

The overall mean for all components was calculated to validate user interactivity with the MobileCalliph Application prototype based on the I-HATIC Framework. The overall mean score is 4.13, which is the percentage was 82.68%> indicating high user engagement with the MobileCalliph Application prototype. It confirms that the MobileCalliph application successfully encourages users to keep using it by implementing the I-HATIC Framework that meets research objectives and provides the tools to attract young generations to learn Islamic calligraphy handwriting and gain a better understanding of Islamic calligraphy. Table 4.22 below summarises the Mean and the overall Mean in the Prototype evaluation.

Table 4.22
Summary Of Mean And Overall Mean In Prototype Evaluation

| Components | Total Mean Average |
|---|---|
| Student Component | 4.05 |
| Tutoring Component | **4.15** |
| Expert Component | 4.16 |
| Interactive Interface Component | **4.17** |
| **Overall Mean** | **4.13** |

## 4.5 Findings of Phase 4: Framework Documentation

For the final phase of this research study, a comprehensive framework documentation was meticulously prepared to keep all the data and findings related to the I-HATIC Framework research study. This documentation will include the outcomes from the various stages, beginning with the investigation phase, which provides a thorough literature review of the relevant literature. Then, preliminary study findings and analyses were systematically recorded.

Furthermore, all critical processes and activities undertaken during the development phase were documented. This included expert consultations, face validity assessment, and an evaluation process applied to the prototype. Detailed records of analyses, calculations and evaluations were maintained to ensure transparency and traceability. The records show that the study was carried out methodically and by accepted scientific norms. It also verifies that the study meets the objectives and provides a comprehensive answer to the research questions; as a result, it contributes significantly to the field. Hence, all the data, raw, proof, table and information related to the I-HATIC Framework were documented clearly.

## 4.6 Summary

This chapter provides an overview of the evaluation process for this research project, utilizing multiple validation methods. The face validation phase was carried out to determine whether the items in the I-HATIC Framework instrument were appropriate, reasonable, and clear. In addition, expert validation was conducted using the content validity method, where experts evaluated the relevance and clarity of the I-HATIC Framework's items. The results were quantified to provide insight into the framework's effectiveness and gather feedback and recommendations for refinement. This chapter also includes an assessment of user engagement through a user prototype demonstration of the MobileCalliph application. The overall mean engagement is 4.13, showing a strong interaction between the user and the application. Lastly, recommendations and suggestions from the experts are presented to guide potential enhancements to the I-HATIC Framework. These suggestions highlight areas for

enhancement and aim to ensure the framework remains practical for calligraphers or beginners to practice writing Islamic calligraphy.

# CHAPTER 5
# CONCLUSION AND RECOMMENDATION

## 5.1 Introduction

This chapter presents the conclusion and recommendations of the research, beginning with the identification of the framework's problem and progressing to the stage where the application prototype will be tested. Problems encountered, limitations identified during the research, and any foreseeable issues that affected the application development process are outlined. Future enhancements to the application can also be stated.

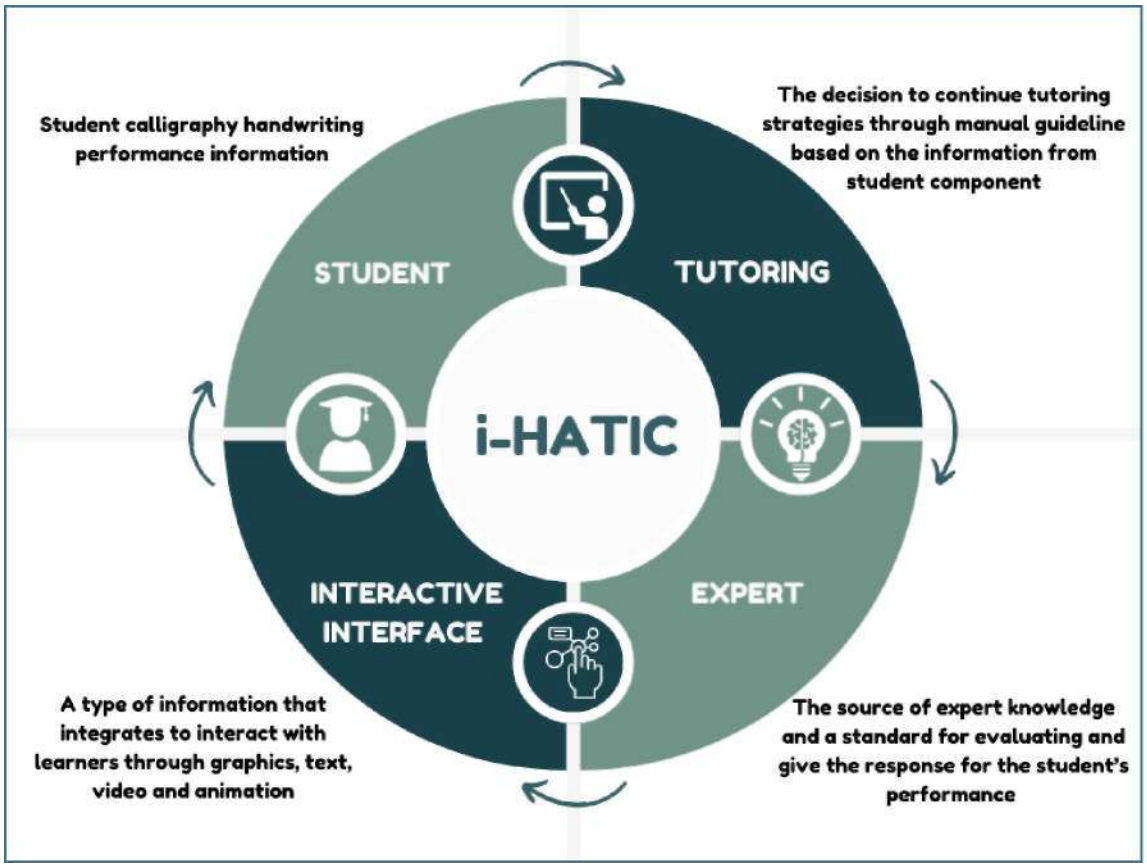
## 5.2 Summary of the research

Upon the completion of this research project, all objectives are met. The application, based on the I-HATIC Framework, has been successfully developed to help beginners and young generations learn Islamic calligraphy. Based on the research methodology, the theoretical investigation was conducted in Phase 1 through a literature review and expert interviews. All of these were done to meet objective 1, which is to identify the components of interactive tutoring, handwriting, and Islamic calligraphy (1-HATIC Framework).

Phase 2 was framework development and validation of the I-HATIC Framework. The application's conceptual framework components and user interface were designed in a storyboard in the development phase. The result of Phase 2 was to design an interactive Islamic Calligraphy Handwriting application that met Objective 2. Additionally, two research activities were conducted in Phase 2, validating the framework with expert input. Experts were selected based on their inclusion and exclusion criteria. Phase 3 was conducted to evaluate interactivity through user testing, aiming to achieve Objective 3, which is to assess the I-HATIC Framework using a handwriting Islamic calligraphy application. Phase 4 was concluded with the documentation phase. Figure 5.1 shows the final I-HATIC Framework, synthesised

from the six existing frameworks to make it more interactive.

Figure 5. 1 The Final I-HATIC Framework




## 5.3 Research Questions and Objective Revisited

The study successfully addresses three research questions and meets the objectives. The research was completed through a series of processes, which will be discussed below.

### 5.3.1 Research Questions and Objective 1

The first research question of this study is, *"What are the key components of Interactive Tutoring Handwriting Islamic Calligraphy Conceptual Framework (I-HATICFramework)?"* To achieve and address this research question, an objective was

undertaken to identify the components of the Interactive Tutoring Handwriting Islamic Calligraphy Conceptual Framework (I-HATIC Framework). The identification process began by identifying the suitable components. A content analysis, comparative analysis, and expert consultation were conducted to determine the relevant components of the I-HATIC Framework. After several analysing, four key components were identified for I-HATIC framework which is Student Component, Expert Component, Tutoring Component and Interactive Interface component. Moreover, over a hundred articles were reviewed using the keywords Tutoring System, Intelligent Tutoring System, Islamic calligraphy Handwriting, and Tutoring Handwriting application.

### 5.3.2 Research Questions and Objective 2

The second research question is *"How to develop an Interactive Tutoring Handwriting Islamic Calligraphy Conceptual Framework?"*. To answer this question, the Intelligent Tutoring System (ITS) was identified to develop this framework. Many articles related to tutoring handwriting mostly use ITS features as the main component in the tutoring framework. After several findings in research, six existing framework that related with I-HATIC framework can be a use as references. Next, the mapping process of six existing framework to be ensured that the framework and literature review shared similar criteria and definitions. This step facilitated the extraction of relevant criteria that would inform the development of an instrument for the I-HATIC Framework. The second objective was achieved by following these steps and procedures: *"To develop the Interactive Tutoring Handwriting Islamic Calligraphy conceptual Framework (I-HATIC Framework)"*.

### 5.3.3 Research Questions and Objective 3

The final research question is, *"How is the proposed I-HATIC Framework through tutoring handwriting Islamic calligraphy application?"*. To solve the research question, the initial draft of the I-HATIC Framework was distributed to ten experts with various backgrounds, academia and experience to validate and give feedback for improvement. Additionally, the prototype of the I-HATIC framework, the

MobileCalliph application, was undergoing user evaluation to measure user engagement and enjoyment related to the I-HATIC Framework. During user evaluation, the participants were given the prototype to be tested, and the questionnaire was distributed to the participants to give feedback after testing the prototype based on the I-HATIC Framework. As a result of these efforts, the final research objective was achieved: 'To *evaluate the I-HATIC Framework through tutoring handwriting Islamic calligraphy application.'*

## 5.4 Contribution of this study

This study contributes to the development of the I-HATIC Framework, providing insight for future developers and researchers to create interactive tutoring handwriting applications. This framework is simpler and more interactive, making it easier to attract developers to create handwriting applications. Moreover, this framework can be the guideline for researchers and developers to find more about tutoring Islamic calligraphy framework.

Furthermore, this research also contributes to the development of an instrument to measure the interactivity of the framework. It facilitates designers and developers in creating new handwriting applications.

Next, a new interactive handwriting application prototype was also developed based on the framework. The I-HATIC framework can have a greater impact on the next developer, enabling them to create more exciting games or applications. From this study, the researcher can explore handwriting frameworks and calligraphy, gaining an understanding of the procedures involved in developing a framework.

## 5.5 Limitations and Recommendations

There are some limitations during the development of the I-HATIC Framework. Firstly, the I-HATIC Framework primarily utilises Intelligent Tutoring Systems (ITS) as its main feature in developing the I-HATIC Framework component. Moreover, the I-HATIC Framework only focuses on two main calligraphies, Nasakh and Thuluth. These two calligraphy scripts, Nasakh and Thuluth, can attract more young generations

to write calligraphy because they are simple and easy to follow. Next, the I-HATIC Framework focuses on using a tablet or mobile phone because they are easy to carry everywhere, rather than a laptop or desktop. Lastly, the target user for the I-HATIC Framework prototype to evaluate among young generations is those aged from 10 to 12 years old. This is because this target user can use the prototype to practice handwriting calligraphy and be easily attracted to a new, enjoyable learning application.

## 5.6 Conclusion

Based on the overall progress of the research, the research objectives have been achieved, as can be concluded. The research employed a comprehensive approach that included problem identification, framework development, evaluation, and detailed documentation, all of which were conducted to achieve the study's objectives. Overall, the findings have shown that an interactive tutoring handwriting Islamic calligraphy application can motivate users to learn calligraphy writing.

Although this study has limitations and provides suggestions for future research, it demonstrates that applying a conceptual framework in interactive tutoring for handwriting is practical and effective. The research findings highlight that the potential of an interactive tutoring framework for handwriting Islamic calligraphy can positively impact users and create a solid foundation for future researchers to explore and make improvements. This framework could offer benefits to users, especially in the education field, by facilitating the learning of handwriting in Islamic calligraphy, thereby contributing to a more enjoyable learning experience.

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# APPENDICES

# APPENDIX 1

## One of the Letters for an Expert's appointment

**Kolej Pengajian Pengkomputeran, Informatik dan Matematik**

**Universiti Teknologi MARA (UiTM)**
Cawangan Melaka, Kampus Jasin
77300 Merlimau, Jasin
Melaka Bandaraya Bersejarah
Tel: (+606) 2645000

**UNIVERSITI TEKNOLOGI MARA**

Reference: 100 - KJM (KPPIM 14/3/4/3)
Date: 1st March 2024

**DR. SHELENA A/P SOOSAY NATHAN**
Pusat Pengajian Diploma
Universiti Tun Hussein Onn Malaysia (UTHM)
Hab Pendidikan Tinggi Pagoh
84600 Pagoh, Johor

Dear Dr. Shelena,

**APPOINTMENT AS AN EXPERT REVIEWER FOR A CONCEPTUAL FRAMEWORK FOR INTERACTIVE TUTORING HANDWRITING ISLAMIC CALLIGRAPHY**

Thank you for agreeing to be an expert reviewer for the following student master's study. Below are the details:

| | |
|---|---|
| **NAME OF STUDENT** | **: NURUSSABIHAH BINTI JAMALUDDIN** |
| **UiTM STUDENT NO.** | : 2020280878 |
| **FACULTY** | **: COLLEGE OF COMPUTING, INFORMATICS AND MATHEMATICS** |
| **RESEARCH TITLE** | **: A CONCEPTUAL FRAMEWORK FOR INTERACTIVE TUTORING HANDWRITING ISLAMIC CALLIGRAPHY** |
| **MAIN SUPERVISOR** | **: Ts. DR NURUL HIDAYAH BINTI MAT ZAIN** |
| **CO-SUPERVSIOR** | **: Ts. DR NORIZAN MAT DIAH** |

2. For your information, the student would like to humbly solicit your opinions, suggestions, or recommendations to review and validate her initial framework: The i-HATIC Framework, as a strategy to attract the young generation to learn Islamic calligraphy.

3. We look forward to receiving your feedback. Kindly provide feedback on the form at your earliest convenience, preferably within two weeks: **14th March 2024.** You can confirm your participation in this study and start the review process by referring to this link: Expert Review Form

5. Your cooperation, time, and assistance are greatly appreciated. Once again, thank you in advance for your time and effort in making this research successful.

Thank you.

Sincerely,

**Ts. DR. NURUL HIDAYAH MAT ZAIN**
Senior Lecturer
Universiti Teknologi MARA (UiTM) Cawangan Melaka
Kampus Jasin, 77300 Merlimau, Melaka
nurul417@uitm.edu.my

# APPENDIX 2

## Publications of ScoRED 2024

2024 IEEE 22nd Student Conference on Research and Development (SCOReD), December 19-20, 2024

# Blending Tradition with Innovation: An Interactive Tutoring in Handwriting Islamic Calligraphy

Nurussabihak Jamaluddin
*College of Computing, Infonnatics and Mathematics*
*Universiti Teknologi M.1R.I*
Shall Alain. Selangor. Malaysia
sabihalijainaluddin95@ginail.com

Nurul Hid ayah Mat Zain*
*College of Computing, Infonnatics and Mathematics*
*Universiti Teknologi MARA*
*Cawangan Melaka, Kampus Jasin*
Merliinau Melaka, Malaysia
nurul417@uitnLedu.my

Norizan Mat Diali
*College of Computing, Infonnatics and Mathematics*
*Universiti Teknologi MARA*
Shall Alam. Selangor. Malaysia
norizan289@uitm.edu my

*Abstract*—The most popular way of learning Islamic calligraphy is face-to-face, under the supervision of teachers, tutors or trainers. However, finding an expert to teach handwriting Islamic calligraphy is difficult. Therefore, this paper proposed an interactive tutoring in handwriting Islamic calligraphy framework, namely the I-HATIC framework, as a guideline for designing and developing tutoring applications specifically for handwriting Islamic calligraphy. The tutoring application based on the proposed I-HATIC framework desciibes how human and computer interaction creates good calligraphy or style handwriting in interactive ways. It is motivated by the lack of a well-trained trainer teaching handwriting Islamic calligraphy. This paper discusses the existing frameworks, theoretical foundations, issues, and trends related to handwriting Islamic calligraphy. As a result, the proposed I-HATIC framework can be a guideline in producing up-and-coming handwriting Islamic calligraphy tutoring applications to attract more young generations to explore Islamic calligraphy and solve the problems of limited well-trained trainers.

*Keywords—Interactive, Tutoring Application, Islamic Calligraphy, Handnriting Calligraphy*

### I. INTRODUCTION

Nowadays, technologies can be used in education [1], health [2], cultural heritage [3] or campaigns [4] to transmit information to all people. People, especially students or teachers, mostly use phones, tablets, the internet or applications to teach, learn and communicate. They learn through learning applications containing education systems to make it easier to access anywhere. The development of education communication technologies can provide new possibilities and opportunities for educators to expand their creative skills in teaching [5]. Furthermore, users can improve their skills and behaviour through learning applications from passive to active.

Islamic calligraphy, known as *Kliaf,* has been popular for generations worldwide. Khat is popular because of the beauty and uniqueness of the strokes in each letter, which symbolize how people write to communicate and show the beauty of letters in the Quran. After the evolution of the Quran, Islamic calligraphy is the script that appeared to write the Quran in noble and beautiful styles [6].

Currently, people use Islamic calligraphy as an interior or exterior design painting aspect, especially in mosques and famous Islamic buildings. Islamic calligraphy writing style is a source of inspiration and a starting point in communication [6]. Islamic typography and Jawi script were inspired by Islamic calligraphy. Jawi script is used in the Malay community and has become their identity and an essential role in civilization and knowledge to spread Islamic knowledge in the ASEAN region [7]. Moreover, Islamic typography is used to type letters and text in graphic space and become a branch of graphics [8].

Despite the enormous success of technologies in education as learning applications, there is a way to explore and learn handwriting Islamic calligraphy. Previous studies show the uses of technologies in education as a part of collaborative learning tools practices to improve creative level, problem-solving skills. decision-making power, critical thinking, moral values, and self-confidence [5].

A tutoring system is a standard educational application that can guide the creation of a style or calligraphy handwriting path for some new learners [9]. It is a concept like paper as a prototype and a computer as a teacher using a guideline when students study how to create handwriting calligraphy properly. It provides some stroke features to identify the gestures from calligraphy handwriting [10], [11]. Furthermore, intelligent tutoring can put human and computer technology in close interaction and suggest, evaluate, produce, modify, and select the output after the evaluation as a response [in.

Hence, this sUidy was explored because of the problems people face in the current situation, such as a limited number of trainers or teachers teaching handwriting Islamic calligraphy. Besides, there are limited interactive features for students to practice or train in calligraphy handwriting. The I-HATIC guides the developer in developing an application for handwriting Islamic calligraphy. At the same time, users can feel the excitement of learning.

### n. LITERATURE REVIEW

#### *A. Handwriting Islamic Caihgraplty*

Handwriting Islamic calligraphy symbolizes the beauty of Islam and its identity. During the early period of handwriting Islamic calligraphy, two types of script were always used: the regular script and the *Kiific* script. The regular script is always used to write about people's daily life needs, such as a letter for a King and emperor of Roman and Persian Kingdoms, while another script is the Kufic script used to write die Holy Quran [12].

The evolution of the Arabic calligraphy script arose because two significant parts lacked elegance and standards of scripting regulation to the aim of Arabic calligraphy honouring the word of Allah, which needed reform. After the revolution, some other scripts were successfully scripted by Ibn Muqlah. the Abbasidain vizier, and calligrapher. which are six cursive scripts: *Naskh, Thuhith, Muhaqqaq, Rayhani, Riq'a* and *Tawqi.* Table I shows die example of six cursive

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# APPENDIX 3

One of Certificates for the Expert's contributions

Certificate

OF ACKNOWLEDGEMENT

PROUDLY PRESENTED TO

Dr. Shel&i\&a/p
Q^VV [\athan

Thankyou for your Invaluable contribution as an expert reviewer. Your expertise and Insights have played a crucial role in ensuring the quality and credibility of the work, and we truly appreciate the time and effort you invested in this process.

**SENIOR LECTURER**
UNIVERSITI **TEKNOLOGI MARA (UITM) CAWANGAN MELAKA**
**KAMPUS JA5IN. 77300 MERLIMAU. MELAKA**

Certificate

OF ACKNOWLEDGEMENT

PROUDLY PRESENTED TO

Nur Maherah b. imt
Jamaluddin

Thank you for your invaluable contribution as an expert reviewer. Your expertise and insights have played a crucial role in ensuring the quality and credibility of the work, and we truly appreciate the time and effort you invested in this process.

*~fr#r.*f»U+fuLJ,rft}.* *#W*%*

**SENIOR LECTURER**
**UNIVERSITI TEKNOLOGI MARA (UITM) CAWANGAN MELAKA**
**KAMPUS JASIN, 77300 MERLIMAU, MELAKA**

A

# APPENDIX 4

## One of an Expert's CV from the industry


Seeking a career opportunity in the area of education, administration, learning & development and event management. A self-driven and hardworking individual with strong interpersonal skill. Willing to learn new things to develop myself. Embrace teamwork and work well with other people.

### OPERSONAL INFO

| | |
|---|---|
| Name | Nur Maherah binti Jamaluddin |
| Age | 26 years' **old** |
| D.O.B | 18 November 1996 |
| Relationship | Married |
| Nationality | Malaysian |

V. 012-3708980

H maherah.1amaluddinl8@gmail.com

9 Muar, Johor

### ($ LANGUAGES

Malay
English
Arabic

### TECHNICAL COMPETENCIES

Microsoft Word
Microsoft Power Point
Microsoft Excel
Adobe Photoshop
Adobe Illustrator
Movie Maker

### jjj$ REFERENCE

Dr Khairunneezam Bin Mohd Noor
neezam@u5im.edu.mv
06-7988403

Mohd Azhar Bin Ibrahim Residi
azhar@usim.edu.mv
019-6229931

### EDUCATIONAL **BACKGROUND**

- Universiti Sains Islam Malaysia (USIM) 2016 - 2020
  BSc. (Hons) in Da'wah and Islamic Management
  Overall CGPA : 2.97
  *Modules: Counseling, Psycology Da'wah, Hifz Nusus, Da'wah Tatbiqi, Akhlak and Sufism, Islamic Management & Leadership, Human Resource Management, Human Capital Development, Organizational Behavior & Management, Counselling Theory & Philosophy, Islamic Work Ethics*

Q SMKA Segamat, Segamat, Johor 2014 - 2015
Malaysian Higher School Certificate (STPM)
Overall CGPA : 2.75
*Subjects: General Study, History, Shariah, Arabic Language*

*j* SMK Bandar Maharani, Muar, Johor 2013
Malaysian School Certificate (SPM)
Achievement: 4As

### lil **WORK EXPERIENCE**

Madrasah Tahfiz Al Quran At Tanwiriah, Muar Sep 2020 - Now
Teacher and Warden for Secondary School
*Responsibilities: Presenting lessons in a comprehensive manner and use visual audio means to facilitate learning the understanding of Arabic language and Islamic knowledge to studens age 13-17 years old and monitoring, counselling, and mentoring students who reside in campus hostels.*

Social Security Organization (SOCSO), Melaka Feb - May 2020
Employment Insurance System Department
Internship Trainee
*Responsibilities: Ensure proper management of documents, keep task record, assist in managing events at branch level, conduct research on Return to Work and Employment System Officer, assist in managing external stakeholder*

Pasti Ar-Rahmah, Muar, Johor Jan - Sep 2016
Teacher for Toddler Class
*Responsibilities: Caretaker, deliver creative and interactive activities to students age-3-4 years old, coordinate field trip, communicated with parents to report on students' behaviors*

### O **CURRICULAR ACTIVITIES**

Global Islamic Student Outreach Program (GISO)
Multimedia & Publicity EXCO
*Activities: Collaborate with Seoul International University, South Korea to organize student outreach program as part of fulfilling social responsibilities, deliberative dialogue with local Islamic community in Seoul, etc.*

Dakwah & Islamic Management Committee (DIMAC)
Assistant Vice President
*Activities: Organize weekly program e.g CV writing workshop, Adobe Photoshop training & school engagement program*

U Islamic Calligraphy & Fine Arts Course
Participant
*Activities: Learn various types of Islamic calligraphy and produce contemporary and traditional Islamic artworks*

### ACHIEVEMENT & CONTRIBUTION

- Islamic Calligraphy (Murabba') Seminar, Segamat
  Speaker
  *Contribution: Preparing and delivering Islamic Calligraphy (Murabba') lessons to the high school students in Segamat*

Creative Youth League Competition by Malaysian Communications and Multimedia Commission (MCMC)
Participant
*Achievement: Lead the team to produce a cyber-threat and internet awareness video, entitled "Klik dengan Bijak"*

Hands-On Program for Entrepreneur ships (HOPE@USIM)
General Manager Nairn Takzim Enterprise
*Achievement: Lead the team to grow business for various products including healthcare, food and beverages (achieved sales of approx. RM3,000 in 3 months).*

# APPENDIX 5

## Research Ethics Form

**HaSS H5**

UNIVERSITI TEKNOLOGI MARA

l'ejat>at
Timbalan Naib Canselor
(Penyelidikan dan Inovasi)

Reference 600-TNCPI(5/1/6)
Our reference REC/11/2021 (MR/892)
Date 23rd November 2021

**Ts Dr Nurul** Hidayah **Binti Mat Zain**
**(Nurussabihah Binti Jamaluddin -2020280878)**
Faculty Of Computer And Mathematical Sciences
Universiti Teknologi MARA
40450 Shah Alam
SELANGOR

Dear Ts Dr Nurul Hidayah Binti Mat Zain,

**APPROVAL LETTER - UiTM RESEARCH ETHICS COMMITTEE**

Thank you for submitting your research proposal to Research Ethics Committee (REC). After considering your application, the Committee approved your proposal entitled "Mixed-Initiative Intelligent Tutoring Framework for Handwriting Game in Islamic Calligraphy" at Faculty of Computer Science and Mathematics, UiTM Campus Jasin, Malacca.

Details of the approval are as follows:

| | |
|---|---|
| **Ref. number:** | REC/11/2021 (MR/892) |
| **Approval Period:** | 23rd November 2021 until 30th April 2022 |
| **Authorised personnel:** | 1. Ts Dr Nurul Hidayah Binti Mat Zain<br>2. Nurussabihah Binti Jamaluddin |

The UiTM Research Ethics Committee operates in accordance to the ICH Good Clinical Practice Guidelines, Malaysia Good Clinical Practice Guidelines and the Declaration of Helsinki. The approval of this project is conditional upon your continuing compliance with these guidelines and declaration.

We draw to your attention the requirement that a report on this research, must be submitted every 12 months from the date of the approval or on the completion of the project, whichever occurs first. Failure to submit reports will result in withdrawal of consent for the project to proceed. Amendments, if any, to the study documents are to be submitted to REC for approval.

If you require further information, please contact REC Secretariat at 03-55448069/03-55442794 or email at recsecretariat@uitm.edu.my.

Yours sincerely,

PROFESSOR DATO DR **ABU BAKAR ABDUL MAJEED**
Chairman
UiTM Research Ethics Committee

c.c: Dean, Faculty Of Computer And Mathematical Sciences, UiTM

**Universiti lekiiologi MARA**
Aras 3. B.ui^uiKtii IVoWBHOl
40430 Siudi Alum, Svl,ui,ur. MALAYSIA
Tel: (*603) 5544 2004/2255
F.ik-.: (-HS03) .5511 2070

**9 UiT**

*i\Sl, **

# APPENDIX 6

## Face Validation's Questionnaire

**Face Validation for A Conceptual Framework for Interactive Tutoring in Handwriting Islamic Calligraphy Instrument**

Assalamualaikum and very good day. I am Nurussabihah binti Jamaluddin, a student pursuing a Degree of Master of Science (Computer Science) from the College of Computing, Informatics, and Mathematics, UiTM Shah Alam. I am inviting you to participate in this study to evaluate my master's research about A Conceptual Framework for Interactive Tutoring in Handwriting Islamic Calligraphy. Looking at your rich background in academic, research, or industrial expertise, I would like to humbly solicit your opinions, suggestions, or recommendations to review or improve my research study.

INTRODUCTION OF RESEARCH

Despite the big success of technologies in education as learning application, there is a way to explore and learn Islamic calligraphy handwriting. This art culture not much attracted more people to learn. If people want to learn Islamic calligraphy handwriting, they need to attend a class that makes it more time-consuming. So, all people, especially the young generation, can learn Islamic calligraphy handwriting through technologies like smartphones or tabs. Learning through application concept like interactive tutoring handwriting Islamic calligraphy can attract more people in Islamic calligraphy in modern way. As a new technology teaching method, this potential is motivated by the lack of well-trained trainers in the handwriting calligraphy arts industry. They are mostly teaching trainer that teaches calligraphy from a teacher in school. It hard for a trainer to train and guide a new learner to practice every day. Lastly, this research about Conceptual Framework for Interactive Tutoring Handwriting Islamic calligraphy to develop handwriting application for Islamic calligraphy. This research has been productive because of the problem people face in the current situation, such as a lack of teaching trainers or teachers to teach Islamic handwriting calligraphy, lack of interaction between student and teacher, and lack of student practices or training in calligraphy handwriting. In this framework, we can show the system guide users to write calligraphy handwriting properly. At the same

time, users can also feel the excitement in learning because it has close interaction in suggesting, producing, modifying, and evaluating in quick responses.

**PURPOSE OF RESEARCH**

The research study aims to develop a framework for interactive tutoring handwriting Islamic calligraphy as a i-HATIC framework which is a strategy to attract young generation learn Islamic calligraphy

**RESEARCH PROCEDURE**

The panel needs to complete two (2) sections: Section A: Demography Section B: Face validation form The feedback received use is in the range of agree (YES) and disagree (NO). Experts' suggestions and feedback are encouraged to improve the instrument.

**PARTICIPANT IN RESEARCH**

Participation in this research is entirely voluntary. You may refuse to participate in the study or withdraw yourself from participating in the research at any time without penalty.

**BENEFIT OF RESEARCH**

This research study may benefit to developer or application designer, the user and practitioner as they can use this framework as the guideline in learning Islamic calligraphy.

**RESEARCH RISK**

This research involves in education and e-learning environment. There is no potential to risk the effect in emotions, including depression, stress, guilt and loss or low self-esteem during and after research procedure. The research study will not cause any harm of discomfort or effect to any participant's mental and health issues. Participants will be given a consent form before the research procedure, and participant can withdraw from the research procedure without any penalty. All the data will be kept confidential and will be utilized for education and research purposes only. Your attention and cooperation are very appreciated.

**CONFIDENTIALITY**

Please be assured that the investigators will keep your information confidential and will not made public unless disclosure is required by law. By signing this consent form,

you will authorize the review of records, analysis and use of the data arising from this research. That your personal information will be disclosed and remain confidential. If you have any question or any additional information about this research, please contact us via email at Postgrad Student: Nurussabihah binti Jamaluddin - sabihahjamaluddin95@gmail.com Main Supervisor: Ts Dr Nurul Hidayah Mat Zain - nurul417@uitm.edu.my Co-Supervisor: Ts. Dr. Norizan Mat Diah - norizan@tmsk.uitm.edu.my

Thank you.

NAME:*

INSTITUTION:*

POSITION: *

FIELD OF EXPERTISE: *

YEAR OF EXPERIENCE:*

GENDER:

| | |
|---|---|
| Lelaki / Male | |
| Perempuan / Female | |

Please continue to the next section with the actual instrument that will be distribute to the experts for the content validation. Panels experts are not required to answer question in the instrument.

The panel expert needs to access the extent to which the instrument meets the criteria for good research. The face validation criteria are based on a study by Oluwatayo (2012), that will be evaluated in terms of:

1. Use of correct and appropriate grammar
2. Adjusted use of appropriate language
3. Use of correct spelling

4. Correct sentence structure

5. Appropriate writing size

6. Appropriate format

7. Appropriate content

Thank you

**INSTRUCTIONS:**

1. The expert needs to assess the extent to which the instrument (that was explored previously) meets the criteria for a good research instrument by checking the column **(YES / NO).**

2. Suggestions and feedback are encouraged to improve the instrument. 3. The face validation criteria are based on a study by Oluwatayo (2012)

Thank you for your cooperation.

| | **YES** | **NO** |
|---|---|---|
| Use of correct and appropriate grammar | | |
| Adjusted use of appropriate language | | |
| Use of correct spelling | | |
| Correct sentence structure | | |
| Appropriate writing size | | |
| Appropriate format | | |
| Appropriate content | | |

# APPENDIX 7

## Expert's Review Evaluation Questionnaire

**EXPERT REVIEW: A CONCEPTUAL FRAMEWORK FOR INTERACTIVE TUTORING HANDWRITING ISLAMIC CALLIGRAPHY**

Hi and Assalamualaikum. I am Nurussabihah binti Jamaluddin, a student Degree of Master of Science (Computer Science) from College of Computing, Informatics and Mathematics, UiTM Shah Alam. I am inviting you to participate in this study to evaluate my master's research about A **Conceptual Framework for Interactive Tutoring Handwriting Islamic Calligraphy.**

Looking at your rich background in academic, research, or industrial expertise, I would like to humbly solicit your opinions, suggestion, or recommendations to review or improve my research study.

**A: RESEARCH INFO**

**ETHICS APPROVAL**

This research study has obtained ethics committee approval from UiTM Research Ethics Committee with reference number REC/11/2021 (MR/892). The approval of this project research is conditional upon continuing compliance with these guidelines and regulations.

**INTRODUCTION OF RESEARCH**

Despite the big success of technologies in education as learning application, there is a way to explore and learn Islamic calligraphy handwriting. This art culture not much attracted more people to learn. If people want to learn Islamic calligraphy handwriting, they need to attend a class that makes it more time-consuming. So, all people, especially the young generation, can learn Islamic calligraphy handwriting through technologies like smartphones or tabs. Learning through application concept like interactive tutoring handwriting Islamic calligraphy can attract more people in Islamic calligraphy in modern way. As a new technology teaching method, this potential is motivated by the lack of well-trained trainers in the handwriting calligraphy arts industry. They are mostly teaching trainer that teaches calligraphy from a teacher in school. It hard for a

trainer to train and guide a new learner to practice every day.

Lastly, this research about Conceptual Framework for Interactive Tutoring Handwriting Islamic calligraphy to develop handwriting application for Islamic calligraphy. This research has been productive because of the problem people face in the current situation, such as a lack of teaching trainers or teachers to teach Islamic handwriting calligraphy, lack of interaction between student and teacher, and lack of student practices or training in calligraphy handwriting. In this framework, we can show the system guide users to write calligraphy handwriting properly. At the same time, users can also feel the excitement in learning because it has close interaction in suggesting, producing, modifying, and evaluating in quick responses.

## PURPOSE OF RESEARCH

The research study aims to develop a framework for interactive tutoring handwriting Islamic calligraphy as a I-HATIC framework which is a strategy to attract young generation learn Islamic calligraphy.

## RESEARCH PROCEDURE

This research study needs experts' judgement on each item's degree of relevance and clarity. Any feedback and comments or recommendations will be used to improved the proposed framework.

This form contains several sections as below:

Section A: Research info & demographics
Section B: Expert Reviewer Consent Form
Section C:Validation of proposed framework
Section D: Validation of Instrument (Level of Relevancy)
Section E: Validation of Instrument (Level of Clarity)

## PARTICIPANT IN RESEARCH

Participation in this research is entirely voluntary. You may refuse to participate in the study or withdraw yourself from participating in the research at any time without penalty.

**BENEFIT OF RESEARCH**

This research study may benefit to developer or application designer, the user and practitioner as they can use this framework as the guideline in learning Islamic calligraphy.

**RESEARCH RISK**

This research involves in education and e-learning environment. There is no potential to risk the effect in emotions, including depression, stress, guilt and loss or low self-esteem during and after research procedure. The research study will not cause any harm of discomfort or effect to any participant's mental and health issues. Participants will be given a consent form before the research procedure, and participant can withdraw from the research procedure without any penalty. All the data will be kept confidential and will be utilized for education and research purposes only. Your attention and cooperation are very appreciated.

**CONFIDENTIALITY**

Please be assured that the investigators will keep your information confidential and will not made public unless disclosure is required by law. By signing this consent form, you will authorize the review of records, analysis and use of the data arising from this research. That your personal information will be disclosed and remain confidential. If you have any question or any additional information about this research, please contact us via email at

Postgrad Student: Nurussabihah binti Jamaluddin - sabihahjamaluddin95@gmail.com
Main Supervisor: Ts Dr Nurul Hidayah Mat Zain - nurul417@uitm.edu.my
Co-Supervisor: Ts. Dr. Norizan Mat Diah - norizan@tmsk.uitm.edu.my

Thank you.

**B: EXPERT REVIEWER CONSENT FORM**

Category of expert:

| | |
|---|---|
| Academic/Educator | |
| Industry | |

Education level:

| | |
|---|---|
| Degree | |
| Master | |
| PhD or PostDoctoral | |

Area of Expertise:

Designation:

Years of experience:

University/Company Name and Address

**C: VALIDATION OF PROPOSED FRAMEWORK**

**INSTRUCTION TO EXPERT**

Dear experts, the proposed I-HATIC Framework contains four (4) main components and 17 criteria that related to Interactive Tutoring Handwriting Islamic Calligraphy (i-HATIC Framework) as a attraction to develop handwriting Islamic Calligraphy application. This section needs your expert judgement on the degree of relevant of each element to the framework. Your review should be based on definition and relevant terminologies that are provided to you. Please be objective and constructive as possible in your review and use this following rating scale:

**1 = NOT RELEVANT**

**2 = ELEMENT NEED SOME REVISION**

**3 = RELEVANT BUT NEED SOME REVISION**
**4 = HIGHLY RELEVANT**

**Student Component**

Operational Definition: It contains student calligraphy handwriting performance information.

**1 2 3 4 5**

**General comments about the component**

**Tutoring Component**

Operational Definition: The decision to continue tutoring strategies through manual guideline based on the information from student component.

**1 2 3 4 5**

**General comments about the component**

**Expert Component**

Operational Definition: The source of expert knowledge and a standard for evaluating and give the response for the student's performance.

**1 2 3 4 5**

**General comments about the component**

**Interactive Interface Component**

Operational Definition: A type of information that integrates to interact with learners through graphics, text, video and animation.

**1 2 3 4 5**

**General comments about the component**

**Would you like to add any component in i-HATIC Framework? If yes, Please suggest.**

**Would you like to remove any component in i-HATIC Framework? If yes, please suggest.**

**D: VALIDATION OF INTRUMENT (LEVEL OF RELEVANCY)**

Dear experts, this study needs your expert judgement on the degree of relevancy of each item to measure the elements of i-HATIC Framework. Please be as objective and constructive as possible in your review and use the following rating scale:

**1 = Not Relevant**
**2 = Item need some revision**
**3 = Relevant but needs minor revision**
**4 = Highly Relevant**

**Student Component**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| I can trace the calligraphy letter | | | | |
| The tutoring apps show user's score | | | | |
| I can choose the difficulty level | | | | |

| | | | | |
|---|---|---|---|---|
| The tutoring apps shows user's performance | | | | |

**General comments about the criteria**

**Tutoring Component**

| | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| The tutoring app has the tutorial that is easy to follow. | | | | |
| The tutoring app give feedback on the user success or failure. | | | | |
| I will be guided in correcting the error | | | | |
| The tutoring app give a sense of control over interaction between calligraphy letter | | | | |
| The tutoring app offer the reward for right answer. | | | | |

**General comments about the criteria**

**Expert Component**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| The tutoring app give feedback on the user's writing. | | | | |
| The tutoring app allow the user to practice handwriting letter. | | | | |
| I can retry the handwriting letter | | | | |
| The tutoring app response on letter accuracy | | | | |
| The tutoring app response on line quality | | | | |

**General comments about the criteria**

**Interactive Interface Component**

| | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| The tutoring app offer interaction based on user preference | | | | |
| The tutoring app offer easy to practice environment | | | | |
| The tutoring app offer fun learning | | | | |
| The tutoring app provide video and audio auxiliaries in practicing calligraphy letter. | | | | |

**General comments about the criteria**

**E: VALIDATION OF INTRUMENT (LEVEL OF CLARITY)**

Dear experts, this study needs your expert judgement on the degree of clarity of each item to measure the elements of i-HATIC Framework. Please be as objective and constructive as possible in your review and use the following rating scale:

**1= Not Clear**
**2 = Item need some revision**
**3 = Clear but needs minor revision**
**4 = Very Clear**

**Student Component**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| I can trace the calligraphy letter | | | | |
| The tutoring apps show user's score | | | | |
| I can choose the difficulty level | | | | |

| | | | | |
|---|---|---|---|---|
| The tutoring apps shows user's performance | | | | |

**General comments about the criteria**

**Tutoring Component**

| | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| The tutoring app has the tutorial that is easy to follow. | | | | |
| The tutoring app give feedback on the user success or failure. | | | | |
| I will be guided in correcting the error | | | | |
| The tutoring app give a sense of control over interaction between calligraphy letter | | | | |
| The tutoring app offer the reward for right answer. | | | | |

**General comments about the criteria**

**Expert Component**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| The tutoring app give feedback on the user's writing. | | | | |
| The tutoring app allow the user to practice handwriting letter. | | | | |
| I can retry the handwriting letter | | | | |
| The tutoring app response on letter accuracy | | | | |
| The tutoring app response on line quality | | | | |

**General comments about the criteria**

**Interactive Interface Component**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| The tutoring app offer interaction based on user preference | | | | |
| The tutoring app offer easy to practice environment | | | | |
| The tutoring app offer fun learning | | | | |
| The tutoring app provide video and audio auxiliaries in practicing calligraphy letter. | | | | |

**General comments about the criteria**

# APPENDIX 8

## User's Evaluation Questionnaire

### An Interactive Tutoring in Handwriting Islamic Calligraphy

Assalamualaikum dan Salam Sejahtera. Saya Nurussabihah binti Jamaluddin, pelajar Master Degree Sains Pengkomputeran dari UiTM Shah Alam mengucapkan terima kasih di atas kesudian sudara/saudari menjawab soal selidik yang bertanggungjawab menilai perisian " An Interactive Tutoring in Handwriting Islamic Calligraphy" sebagai bahan pengajaran dan pembelajaran. Maklumat yang dikumpulkan adalah bertujuan akademik sahaja. Segala maklumat ini adalah penting dan akan dirahsiakan.

Assalamualaikum and Good Day. I'm Nurussabihah binti Jamaluddin, student Degree of Master of Science (Computer Science) from College of Computing, Informatics and Mathematics, UiTM Shah Alam. I really appreciate for you guys answer all the questions that related with "An Interactive Tutoring in Handwriting Islamic Calligraphy" as the method for learning and education. All the information was collected for academic only. All information is important and will be kept for this project only.

**BAHAGIAN A: LATAR BELAKANG RESPONDEN/DEMOGRAPHIC**

Umur/Age*:

10 years old

11 years old

12 years old

Jantina / Gender:

Lelaki / Male

Perempuan / Female

Saya mempunyai telefon bimbit /1 have mobile phone

| | |
|---|---|
| Ya / Yes | |
| Tidak/No | |

## BAHAGIAN B: PENILAIAN APLIKASI

Sila pilih skala di bawah / Please tick the scale below :

**(1) Sangat Tidak Setuju / Strongly Disagree**

**(2) Tidak Setuju / Disagree**

**(3) Tidak Pasti / Neutral**

**(4) Setuju/Agree**

**(5) Sangat Setuju / Strongly Agree**

**Komponen Pelajar / Student Component**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Pelajar boleh menyalin semula huruf kaligrafi.<br>*The learner can trace the calligraphy letter. 11 to 12 years old years old* | | | | | |
| 2. Aplikasi ini dapat menunjukkan penilaian pelajar.<br>*The tutoring application shows the learner's state.* | | | | | |
| 3. Pelajar dapat mengatasi tahap kesukaran.<br>*The learner can manage the difficulty level* | | | | | |
| 4. Aplikasi dapat menunjukkan prestasi pelajar.<br>*The tutoring application shows the user's performance* | | | | | |

**Komponen Tutor / Tutoring Component**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Aplikasi ini mempunyai tutorial yang mudah diikuti.<br>*The tutoring application has a tutorial that is easy to follow.* | | | | | |
| 2. Aplikasi ini memberikan maklum balas tentang kejayaan atau kegagalan pelajar.<br>*The tutoring application gives feedback on the learner's success or failure.* | | | | | |
| 3. Aplikasi ini akan membimbing pelajar dalam membetulkan kesilapan.<br>*The tutoring application will guide the learner in correcting the error.* | | | | | |
| 4. Aplikasi ini memberi rasa kawalan terhadap interaksi antara huruf kaligrafi.<br>*The tutoring application gives a sense of control over the interaction between calligraphy letters.* | | | | | |
| 5. Aplikasi ini memberi ganjaran untuk jawapan yang betul.<br>*The tutoring app gives a reward for the correct answer.* | | | | | |

**Komponen Pakar / Expert Component**

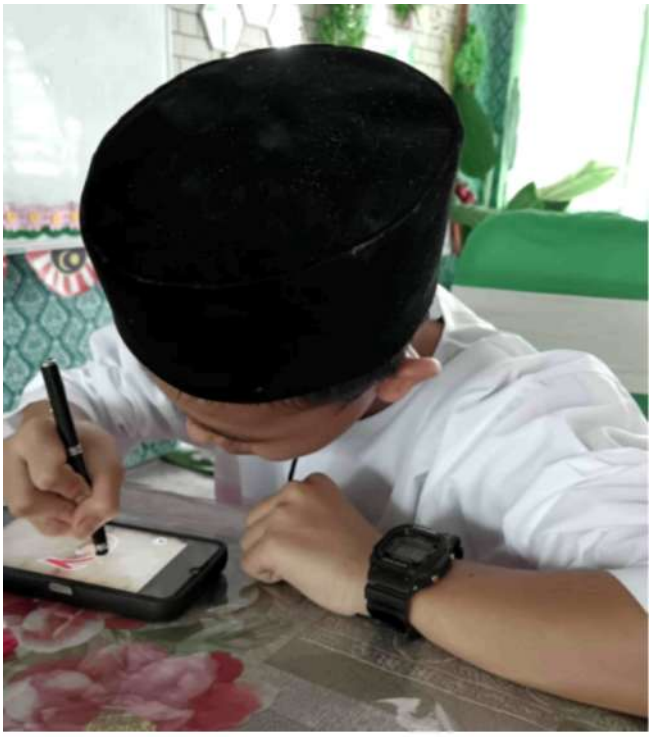
| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Aplikasi ini memberikan maklum balas dengan segera mengenai tulisan tangan pelajar. *The tutoring application gives immediate feedback on the learner's handwriting.* | | | | | |
| *2.* Aplikasi ini membolehkan pelajar berlatih menulis huruf dengan mudah. *The tutoring application allows the learner to practice handwriting letters easily.* | | | | | |
| 3. Aplikasi ini membolehkan pelajar menyalin semula huruf tulisan tangan. *The tutoring application allows learners to retry the handwritten letter.* | | | | | |
| 4. Aplikasi ini memberi maklum balas kepada ketepatan huruf tulisan tangan. *The tutoring application responds to letter accuracy.* | | | | | |
| 5. Aplikasi ini bertindak balas terhadap kualiti barisan huruf kaligrafi. *The tutoring application responds to the quality of lines.* | | | | | |

**Komponen Antaramuka Interaktif / Interactive Interface Component**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Aplikasi ini bertindak balas terhadap kualiti huruf tulisan tangan pelajar. *Tutoring application respond to the quality of learner's handwriting letter.* | | | | | |
| 2. Aplikasi ini menawarkan persekitaran interaktif untuk berlatih menulis. *The tutoring app offers an interactive environment for practising* | | | | | |
| 3. Aplikasi ini menawarkan pembelajaran yang menyeronokkan untuk mendalami pemahaman mereka menulis. *The tutoring application offers fun learning to deepen their understanding* | | | | | |
| 4. Aplikasi ini menyediakan bantuan video dan audio dalam mempraktikkan huruf kaligrafi. *The tutoring app provides video and audio auxiliaries in practicing calligraphy letter.* | | | | | |

# APPENDIX 9

## Evaluation Testing Session

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# AUTHOR'S PROFILE

Nurussabihah binti Jamaluddin is a passionate and dedicated achiever in learning, especially in technology-related Learning. She obtained a Bachelor of Computer Science (Hons) in Multimedia Computing in 2018 from Universiti Teknologi MARA (UiTM) Campus Jasin, Malacca, and a Diploma in Computer Science from Universiti Teknologi MARA (UiTM) Campus Segamat, Johor. She further advanced her academic pursuits by completing her Master's Degree in Computer Science at UiTM Shah Alam, specialising in applications.

Sabihah's area of interest spans various related topics, including games, learning applications, designing, multimedia and human-computer interaction. Beyond her academic work, she has a keen passion for designing and photography by continuously capturing the images and drawing the portraits to keep as sweet moments. Sabihah has actively participated in numerous competitions and extracurricular activities on campus throughout her educational journey. Among her achievements and participation in co-curricular activities on campus are:

- Participated in Game Development Competition and successfully developed interactive, informative game apps named Aedes Game, which educated users to understand how Aedes breeds.
- Volunteer team for Mathematical Competition during Karnival ICT and Matematik
- Team member for Photography Group that consists of 4 members for the program Majlis Anugerah Dekan Kampus Jasin, Melaka
- Volunteer Team during a Program Student's Voice (2014) in UiTM Segamat, Johor

**List of Publication:**

N. Jamaluddin, N. H. M. Zain and N. M. Diah, "Blending Tradition with Innovation: An Interactive Tutoring in Handwriting Islamic Calligraphy,"*2024 IEEE 22nd Student Conference on Research and Development (SCOReD)*, Selangor, Malaysia, 2024, pp. 652-657, doi: 10.1109/SCOReD64708.2024.10872672.