UI/UX Interface Design in the Development of Muhammadiyah Da'wah Application for the Deaf Using the Design Thinking Method

Jefree Fahana[1*], Farid Ma'ruf[2], Faisal Fajri Rahani[3], Syifa Fitriani[4], Sucipto[5]

[1,2,3,4,5]Universitas Ahmad Dahlan (UAD) Yogyakarta, Indonesia

[*]Corresponding author: jefree.fahana@tif.uad.ac.id

Abstract: *The presence of digital technology should help make it easier for the Deaf to optimize da'wah information/materials. However, even though there is technology present today such as hikmahmu.id, it has not been able to facilitate them in obtaining da'wah information because the existing language and features are too complex. For this reason, it is necessary to develop a UI/UX design for hikmahmu.id da'wah application that is more Deaffriendly even though it can still be consumed by the general public. The application design process is inseparable from 2 important components, namely the User Interface (UI) to beautify the appearance, and User Experience (UX) to be able to increase user satisfaction. The UI/UX design in this da'wah application will be developed using the Design Thinking method through several phases, namely empathize, define, ideate, prototype, and test. The Standardized User Experience Percentile Rank Questionnaire (SUPR-Q) method is used as a method to measure and determine the level of efficiency, effectiveness, and user satisfaction in using the application. The results of this study show that the increase in user experience is shown by growth in certain categories such as the display category showing the largest increase (+17.6%), which may indicate that users are directly and clearly feeling the impact of the change in visual aspects. The increase in trust (+12.8%) and ease of use (+12%) also indicates that the platform is seen as more trustworthy and user-friendly, two important factors that affect loyalty (+11.2%). Overall, these improvements show that the changes made have significantly improved the overall user experience, leading to higher user satisfaction, engagement, and retention.*

Keybwords: *Interface Design, Da'wah Application, Deaf, SUPR-Q, Design Thinking.*

1. INTRODUCTION

Da'wah is an activity to convey, invite, or call on others or society to consciously be able to accept, learn, and practice religious teachings, in order to awaken and restore one's potential to one's nature, so that they can live happily in this world and the hereafter [1]. Da'wah in Islam is fardu 'ain, which means that every Muslim has an obligation to carry out da'wah based on the knowledge he has, and fardu kifayah which means the obligation of da'wah that is obligatory to some Muslims [2].

The need for religion in living human life is very important. Religion is very useful and has an important function in human life, namely religion is an absolute element in fostering personal character and building a harmonious and peaceful social life, educating to have a calm soul, free from the shackles of slavery, dare to uphold the truth, have commendable morals and religion can elevate human beings to a higher level than other creatures of God [3].

Law Number 8 of 2016 concerning Persons with Disabilities, in article 1 paragraph 1 explains that a disability is a person who has permanent physical, mental, intellectual or sensory limitations, and in interacting with the environment or attitudes of his community can face obstacles that make full and effective participation based on equal rights difficult. Next, in article 1 paragraphs 5 and 6, it is also explained that the state protects, protects, and strengthens the rights of its citizens who have disabilities. Disability is a more polite or subtle term in describing the condition of a person with a disability [4]. Deaf people have the same right to a proper education as Indonesian citizens [5].

According to data from the Indonesian Ministry of Health, among Indonesia's disabled people, there are as many as 7.03 percent of them who are deaf [6]. In obtaining religious knowledge, deaf people with disabilities find it difficult to understand it because most da'wah uses audio-visual media that cannot necessarily be digested by deaf people, information media or da'wah is needed that is also on the side of the deaf disabled such as sign language to support the deaf in learning religious science [7].

In addition, deaf people still have difficulty accessing da'wah information/materials. This is because deaf people experience hearing loss or no hearing at all [8], so in language and communication sign language is required [9]. For Indonesian deaf people, BISINDO is more pure, effective, expressive and easy to use than SIBI because SIBI is an artificial language and not pure [10]

As a result of the 48th Muhammadiyah Congress, the community became the object of Muhammadiyah's da'wah. One of these communities is the community with special needs (disabled). This result is certainly the handle of all institutional assemblies in compiling programs/activities to pay attention to people with disabilities [11].

The implementation of the existence of the results of the Congress was born the Muhammadiyah Disabled Association (HIDIMU). In order to target Muhammadiyah's da'wah message to people with disabilities, according to Zaenal, Chairman of the Muhammadiyah Social Welfare Service Council D.I. Yogyakarta, Muhammadiyah needs to utilize and develop da'wah applications and technologies to help people with disabilities, especially the Deaf, in receiving Muhammadiyah da'wah materials/information. Hikmahmu.id is a da'wah application that is intended for the deaf [12]. Based on the results of an interview with HIDIMU on June 19, 2024, there needs to be an improvement in a more deaf-friendly appearance because it is difficult for deaf people to understand complex language, besides that the features developed and the material presented must be adjusted to the needs of the deaf.

In application development, it is very important to pay attention to application design. This design is inseparable from 2 important components that are interrelated with each other, namely User Interface (UI) and User Experience (UX) [13]. The User Interface (UI) or application interface has a function to beautify the appearance of the application so that it can increase user satisfaction [14]. Meanwhile, User Experience (UX) is a design process for designing applications based on user experience so that users feel comfortable and relevant to the user experience [15]. UI/UX design in applications can be designed in various methods, one of which is Design Thinking [16].

According to Stanford (2012), Design Thinking is a concept of developing innovations that focus on humans and everything that surrounds them, to build and develop new ideas that are then realized in the form of experiments. The stages in the Design Thinking method include several processes, namely empathize, define, ideate, prototype, and test [17]. Each stage of the Design Thinking method plays a role in identifying the problem that is being faced and answering the problem with useful and effective solutions. Solutions that are made based on a mature understanding of user problems so that they will be able to solve problems and meet the needs of users in using applications.

Based on these conditions, this research will develop a UI/UX design in da'wah applications for the Deaf using the Design Thinking method. To validate the design results, the Standardized User Experience Percentile Rank Questionnaire (SUPR-Q) test method will be applied. SUPR-Q is a questionnaire that can be used to measure the usability of applications comprehensively in web-based applications [18]. Following Maslow's theory of Hierarchy of Needs [20], the aspect of self-actualization is very important in facing this life for all humans. Deaf people need a balance in life, both mentally and physically. The need for religion as part of the fulfillment of the needs of the soul is an inseparable part of the fulfillment of physical needs, namely self-actualization. Da'wah information/materials will equip people with disabilities in being balanced. Increasing knowledge to optimize the abilities of the Deaf can give birth to independence, self-aculization, and well-being [21].

Various kinds of research on applatization are present in an effort to increase awareness of the Deaf, such as the Android-based Communication Application for the Deaf [22]. However, this application still aims to help communication between the Deaf and the general public. In addition, there is also a sign language application for the deaf using the android platform [23]. However, this application is only limited to teaching sign language to understand the deaf or to teach sign language to the deaf. A virtual application of Kata for communication for the deaf based on Android [24]. This application is limited to voice translation media into sign language. Therefore, this research is very important because in this first year of research, it formulates the development of a da'wah application design hikmahmu.id to meet the religious and information needs of the Deaf community.

2. METHOD

This research applies the stages that exist in the Design Thinking method, here figure 2 is the stages of research.
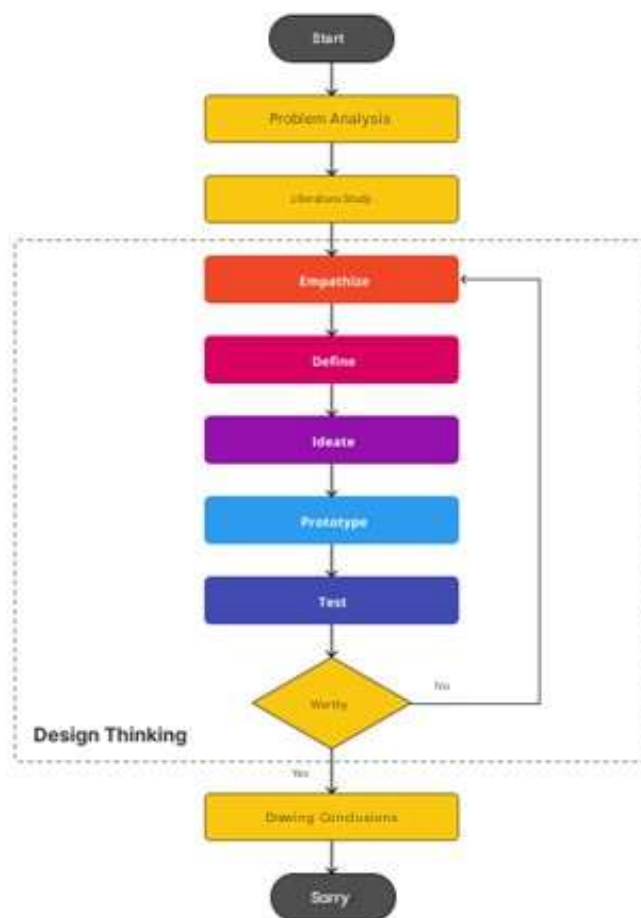
Figure 1. Research Stages

2.1 Problem Analysis

Problem analysis is the initial stage of research, where through this stage the researcher determines the background, identification of the problem, formulation of the problem, the purpose of the research, and the benefits of the research. 2.2 Literature Studies

At the literature study stage, the researcher conducts research to determine the methodology used in the research. This is done by referring to various reference sources such as research report articles, journals, books, and relevant online sites.

2.3 Empathize

Emphatize is the initial stage in the process of exploring and understanding the problems faced by users using an approach that involves direct interaction with users, such as through interviews [25]. Interviews were conducted on the Deaf accompanied by HIDIMU by collecting data on the problems, needs, and target users of the da'wah application. The results of the data that have been collected will then be created a user persona as a reference to provide a type of user that is easy to remember in making the right design decisions.

2.4 Define

Define is the second stage in the design thinking process which aims to analyze and understand information about problems that have been collected during the empathy phase [25]. At the definition stage, an analysis of the problem and the need to articulate what is known about the user will be carried out. 2.5 Ideate

Ideate is the third stage in the design thinking process where the process is carried out to produce ideas or sketches as a basis for designing prototypes [25]. At this stage, the application framework mapping process will be carried out through user flow and site map which will be used as a reference in the design at the prototype stage.

2.6 Prototype

Prototype is a stage or process to produce a design design for a manufactured product that can be tested by users [25]. In this phase, a wireframe design process is carried out to illustrate the basic appearance of the application based on the user flow and site map generated at the ideate stage. Next, the researcher needs to develop the wireframe that has been produced into an interactive prototype so that the testing stages can be carried out.

2.7 Test

The last stage is a test to get appropriate user feedback and feedback based on the results of the prototype design that has been made to find out how effective the solution is to overcome existing problems in order to better meet the needs of users [25]. For the test, SUPR-Q produces a useful, trustworthy application that has an attractive appearance and loyalty from users [18].

3. FINDINGS AND DISCUSSIONS

Muhammadiyah DIY is very concentrated on the development of da'wah, especially da'wah for the community. One of the targeted communities is the disabled community. Hikmahmu.id is a da'wah medium to facilitate deaf people with disabilities in obtaining religious information. However, the results of the assessment using the Standardized User Experience Percentile Rank Questionnaire (SUPR-Q) have an average score of 72.8%, which shows that it is still in grade C. Here are the details of the assessment results for the hikmahmu.id web:

Table 1. The results of the initial assessment of the application hikmahmu.id.

Aspects	Score
Ease	73,2
Belief	73,6
Loyalty	75,6
Display	68,8
Average	72,8

Based on this data, it is very important to re-evaluate the da'wah application so that it becomes a da'wah website that is really friendly to the deaf. So in this research process, we carry out research stages in accordance with design thinking. Here are the stages:

3.1 Empathize Research Your Users' Needs

Empathize is a stage to explore the user's desires [(MeasuringU, 2024)]. This excavation process can be done by interviewing direct users or people who understand the characteristics of application users and asking for comments on the application hikmahmu.id [(Fahana & Oktavian, 2024)]. In addition, through a questionnaire to test whether hikmahmu.id application including the web has good user experience criteria or still needs to be improved. 3.2 Interview

For data mining through interviews because it is included in qualitative, referring to Nielsen (2012) the number of respondents represented at least 5 respondents for qualitative research [(Nielsen, 2012)], so that this study involved 12 respondents with details of 3 Muhammadiyah Deaf observers, namely the Muhammadiyah Association for the Disabled (HIDIMU), 4 teachers of SLB Muhammadiyah Gamping Sleman, 5 Deaf Persons. In addition to the interview, they were also asked to provide responses to the hikmahmu.id website which is the result of the research of Fahana and Oktaviana (2024) [(Fahana & Oktavian, 2024)] The results of the data summary obtained are

1. Deaf people need an educational website about Al-Islam and Muhammadiyah that is friendly to them. The reason is that there is still no religious-based website that meets the needs;

2. Deaf people have obstacles in understanding writing that is too long and complex so that it requires concise writing;

3. Deaf people need a digital Quran that contains sign language;

4. Deaf people need a larger font size;

5. The Deaf need BISINDO sign language that is easy to read in the form of pictures or videos;

6. Deaf people spread hijaiyah sign language that is easy to read in the form of pictures or videos;

7. The posters on the website need to be tidied up again so that the display size of the image is precise;
8. The video presented is too long in duration, and the JBI displayed is too small so it is not easy to understand. 3.3 Questionnaire

Current hikmahmu.id web testing uses the SUPR-Q questionnaire. According to Sauro (2015) SUPR-Q is a method of measuring the user experience of a website, it has eight questions that are used to measure four aspects, namely convenience, trust, loyalty, and appearance. For questions 1 – 7 use the scale Likert 1-5 with the status strongly disagree to strongly agree, and for question 8 using a likert scale of 1-10 with the status of not possible at all until very likely [(MeasuringU, 2024)]. To find out the SUPR-Q assessment, by calculating the average score of all SUPR-Q question items and looking for the average score on each sub-item of the SUPR-Q question [(Pribadi et al., 2019)]. The SUPR-Q questionnaire was created through a psychometric qualification process, consisting of eight best-question items from the results of more than 75 candidates tested by multiple users [(MeasuringU, 2024)].

Testing using SUPR-Q is a quantitative test so that according to Nielsen (2006), to Tester requires a minimum of 20 respondents [(Nielsen, 2006)]. For this study involving 25 respondents, the following is the demographic distribution of respondents in table 2.

Table 2. Demographics of SUPR-Q Respondents

Demographics	Criterion	Sum
Age	≤ 25 years old	5
	26-39	13
	40-49	4
	≥ 50	3
Work	Deaf Teacher	8
	Deaf Observer	17

Table 2 is the result of filling out the questionnaire that has been carried out, the number of each answer is obtained according to the scale of each question.

Table 3. Results of SUPR-Q Questionnaire Questions 1-7 (NFS) Initial Website

Statement (n)	Strongly Disagree (1)	Disagree (2)	Ordinary (3)	Agree (4)	Strongly Agree (5)	Total Sum (Scale x n)
I find the website hikmahmu.id easy to use		2 (8%)	7 (28%)	12 (48%)	4 (16%)	93
I easily moved and searched the menu on the hikmahmu.id website		2 (8%)	9 (36%)	11 (44%)	3 (12%)	90
I feel comfortable with the content on hikmahmu.id website		3 (12%)	8 (32%)	10 (40%)	4 (16%)	90
I feel that the content on the website is hikmahmu.id trustworthy		1 (4%)	9 (36%)	10 (40%)	5 (20%)	94
I will reopen the website hikmahmu.id			8 (32%)	15 (60%)	2 (8%)	94
I find the website hikmahmu.id interesting		3 (12%)	11 (44%)	9 (76%)	2 (8%)	85

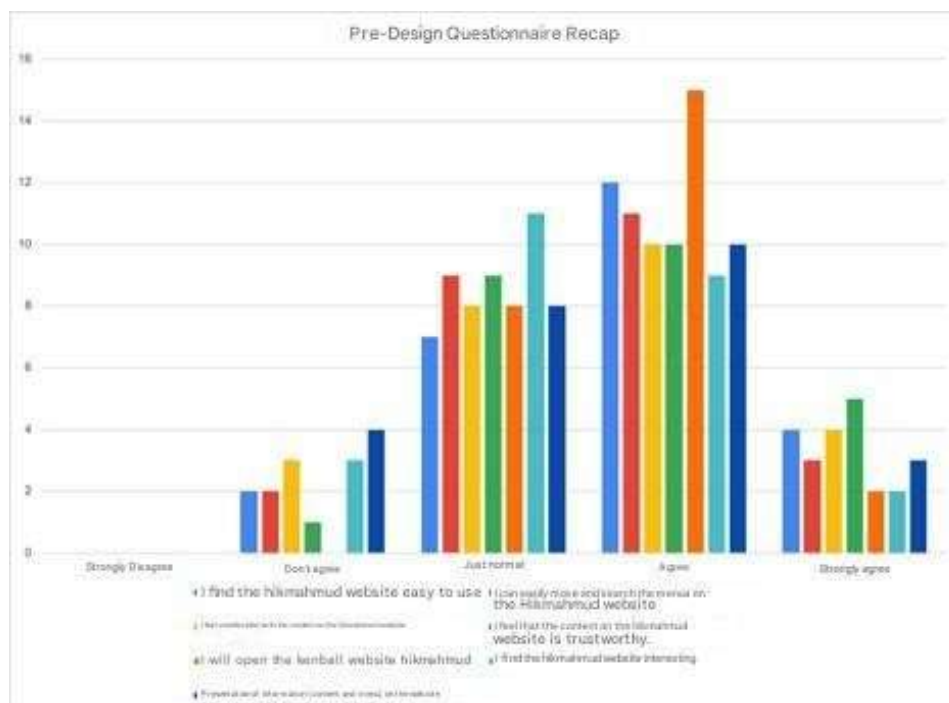| The presentation of information (content and menu) of the website is hikmahmu.id clear and easy to understand		4 (16%)	8 (32%)	10 (40%)	3 (12%)	87

Figure 2. Graphic Info Response Questions 1-7

Table 4. Results of SUPR-Q Questionnaire Question 8 (Non-NFS) Initial Website

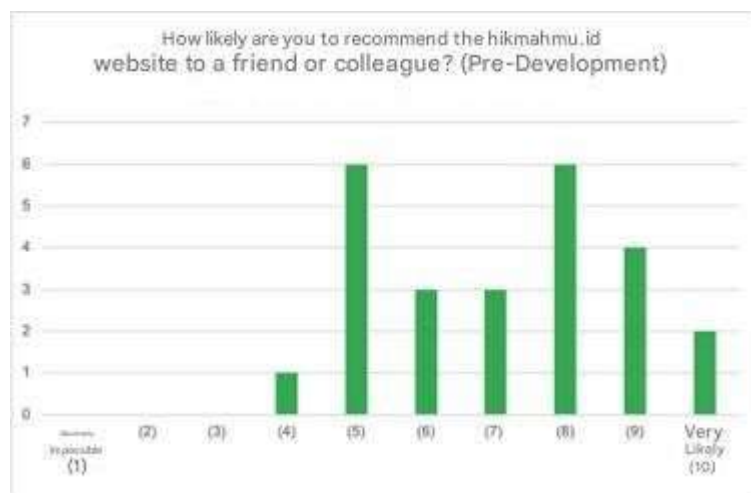| Statement (n)	Never Will (0)	(1).	(2).	(3).	(4).	Ordinary (5)	(6).	(7).	(8).	(9).	Very Possible (10).	Total (Scale x n)
How likely are you to recommend hikmahmu.id site to friends or colleagues?					1 (4%)	6 (24%)	3 (12%)	3 (12%))	6 (24%)	4 (16%)	2 (8%)	177

Figure 3. Answer to question 8

From the data above, it can be known that:
a) Total value of non-NPS questions = 633
b) Total NPS question score = 177
c) Total score obtained = 810
d) Maximum total value = 1350

Based on the data visualization above and referring to the explanation below, it is clear that under the current da'wah website there are still NFS assessments that are not approved and ordinary, including in the Non-NFS assessment there are still those who answer under point 6 which means that the website still cannot be recommended to others as a deaf da'wah website.

The summary of the SUPR-Q assessment above, can be presented in 4 aspects of the assessment, namely Ease, Trust, Loyalty, and Appearance. Table 1 is the assessment score of the 4 aspects in the current hikmahmu.id application.

This shows that the average assessment of the hikmahmu.id is 72.8% which means that the website is included in grade C, adjective rating good according to the usability value conversion scale which is 3 aspects, namely convenience, trust, and display are in a low position, while for the loyalty aspect, it has entered the medium aspect according to the SUPR-Q measurement, with this condition the web hikmahmu.id designed to be deaf-friendly based on the results of research conducted by fahana and Oktavian (2024) [(Fahana & Oktavian, 2024) still needs to be improved in terms of convenience, trust, and appearance according to respondents who are observers and deaf people.

3.4 Define

At the definition stage, conduct a needs analysis to produce applications that are in accordance with the required application specifications.

3.5 Data needs analysis

Aims to identify the data needs to build applications. The data needs in this da'wah application are videos, articles, posters, pictures, prayer times, pictures/videos in Latin sign language, images/videos in hijaiyah sign language, images/videos in sign language symbols/logos of Muhammadiyah, and digital Quran.

3.6 User Needs Analysis

User Needs Analysis is used to determine what needs must be provided for users to operate the deaffriendly da'wah application to be developed. The user needs include the following:

1. Copyright © 2019 T
1) Log in to the admin page;
2) add user administrators;
3) add a submenu of gestures and articles menus;
4) create short Islamic articles accompanied by illustrations of images or videos;
5) add the category of Islamic articles;
6) uploading Islamic posters;

7) uploading images or videos of BISINDO Latin sign language, hijaiyah signs, logo gestures or symbols of Muhammadiyah symbols;

8) uploading Qur'an recitations that contain sign language;

9) To read the Qur'an;

10) upload and arrange prayer times according to their region;

2. End User

1)   viewing and reading Islamic articles that are not too long accompanied by the illusion of images or videos;

2)   search for articles according to the category; 3) view Islamic articles according to categories;

4) looking at Islamic posters;

5) seeing sign language displayed in the form of pictures or videos with the type of sign language of BISINDO Latin letters, hijaiyah signs, logo gestures or symbols of Muhammadiyah symbols;

6) seeing the Quran which has sign language;

7) To read the Qur'an;

8) see the time of prayer;

3.7 System Needs Analysis

1. Functional Needs Analysis

Table 5. New Website Functional Needs

Code	Name
FR-01	The app can display a login page
FR-02	The app can display the administrator page
FR-03	Applications can display user administrator pages
FR-04	The app can display the add user administrator page
FR-05	The application can display the article list page and add articles
FR-06	The app can display an Islamic poster upload page
FR-07	The application can display the page uploading images or videos of BISINDO Latin sign language, hijaiyah signs, logo gestures or symbols of Muhammadiyah symbols
FR-08	The app can display a Qur'an upload page that has sign language
FR-09	The app can display the Qur'an recitation history settings page
FR-10	The app can display the upload page and the prayer time settings according to its region
FR-11	The app can display the article collection page
FR-12	The app can display article collection pages by category
FR-13	The app can display article search fields
FR-14	The app can display Islamic poster pages in the form of images
FR-15	The application can display sign pages in the form of images or videos, sign language BISINDO Latin letters, hijaiyah signs, logo gestures or Muhammadiyah symbols
FR-16	The application can display sign pages in the form of images or videos of hijaiyah sign language
FR-17	The application can display a sign page in the form of a sign language image or video, logo or symbol of Muhammadiyah
FR-18	The app can display pages that read the Quran in sign language
FR-19	The app can display the history page of the Quran with sign language

2. **Non-Functional Needs Analysis**

a. The application can run in the browser through a desktop device and is responsive on the mobile display

b. The application has a simple user interface that is easy to understand for deaf people

3.8 Ideate

1. Idea: Provide a video sign language interpreter that can be accessed in conjunction with a video of a live lecture or religious event. Deaf users can select this option to see a sign language interpreter that provides interpretation of audio content.

2. Idea: Use visual notifications to provide reminders or announcements about religious events, such as with prominent colors or icons. This replaces announcements that are generally delivered verbally.

3. Idea: Developed a simple and intuitive interface design, with large icons and an easy-to-understand layout without requiring a lot of verbal or voice instructions. The goal is to make sure deaf people can easily navigate the pages of the website.

4. Idea: Use infographics and images to explain concepts of religion, prayer, and lessons. This visual content will make it easier for users who have hearing impairments.

5. Idea: Add visual markers throughout the website for events such as prayer calls, worship times, or other special announcements. These markers can be in the form of pop-ups of text or colorful banners that stand out in place of voice-based announcements.

6. Idea: Create an interactive module on the website to learn sign language that is integrated directly with religious content. Not only does this help deaf people interact better, but it also provides opportunities for non-deaf people to learn sign language and communicate with the deaf community.

3.9 Prototype

The results of the design on the new da'wah website can be seen in the following image.
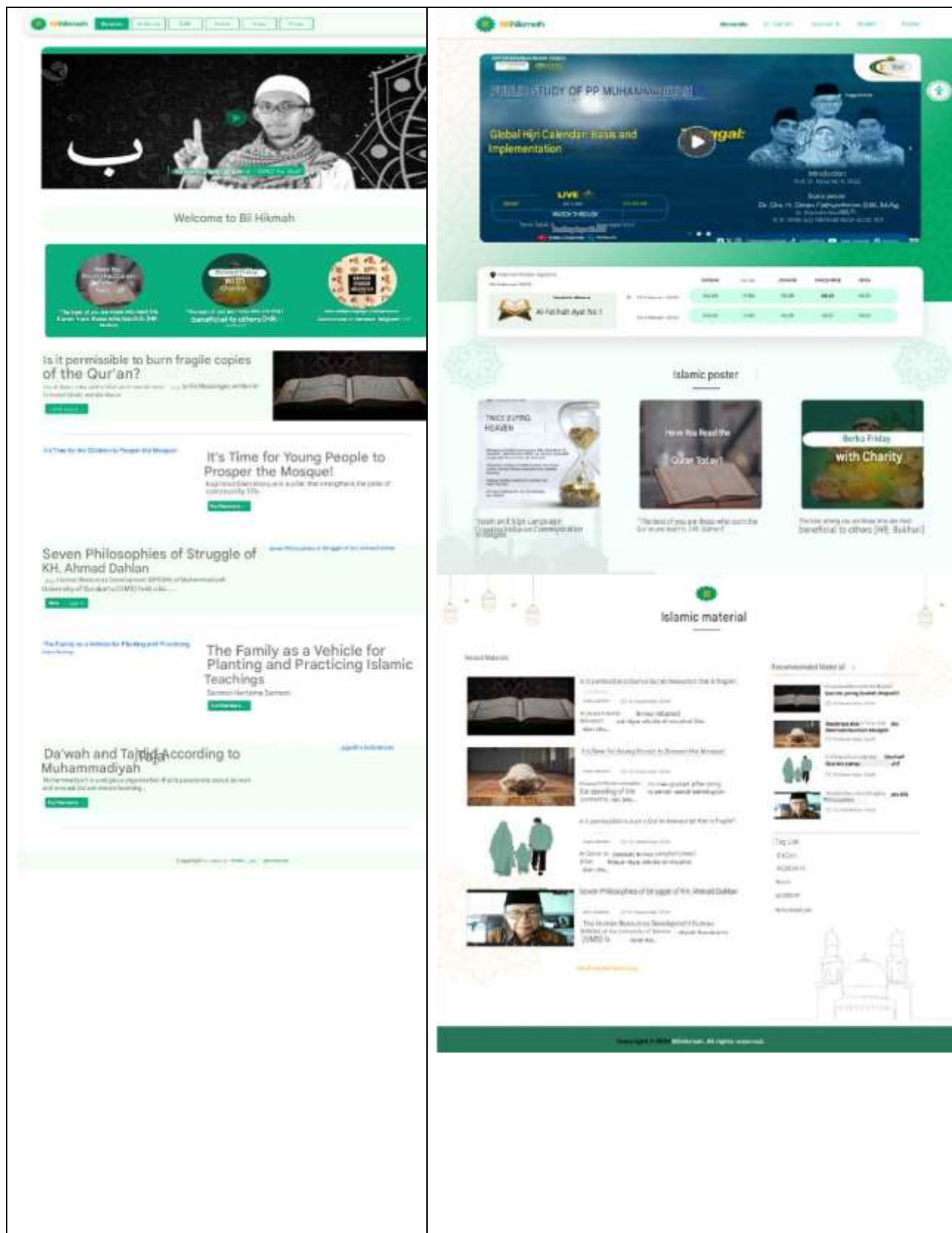
Before	After

Figure 4. Home page of your Hikmah web before and after the repair

Figure 4. It shows that on the home page of the application redesign looks more neatly organized and there is a prayer time schedule feature as part of the functional needs requested by deaf users.
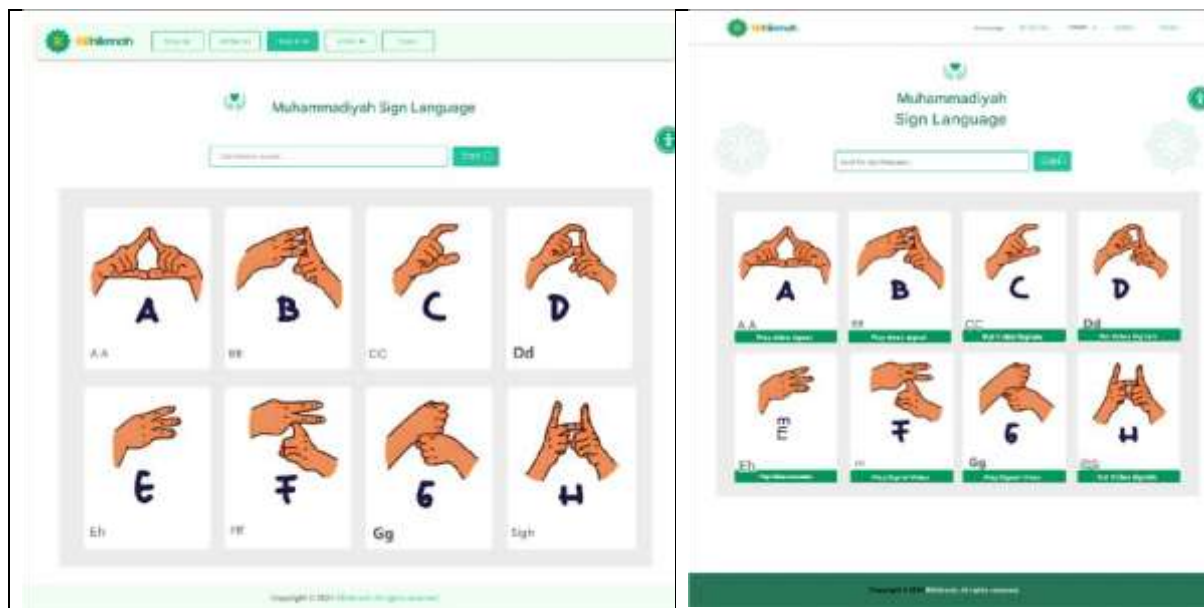
Before	After

Figure 5. Sign language before and after page on hikmahmu.id

Figure 5 is the Sign Language page. On the previous page, sign language was only displayed in the form of images, while on the improvement page, sign language can be displayed in the form of videos or images.

Before	After

Figure 5. Comparison before and after your wisdom website on the page of the Quran

Figure 5 shows that on the previous page for the Qur'an menu, there is no sign language in the form of a translation of the Quran, but on the new page, there is already a sign language in the translation of the Quran.
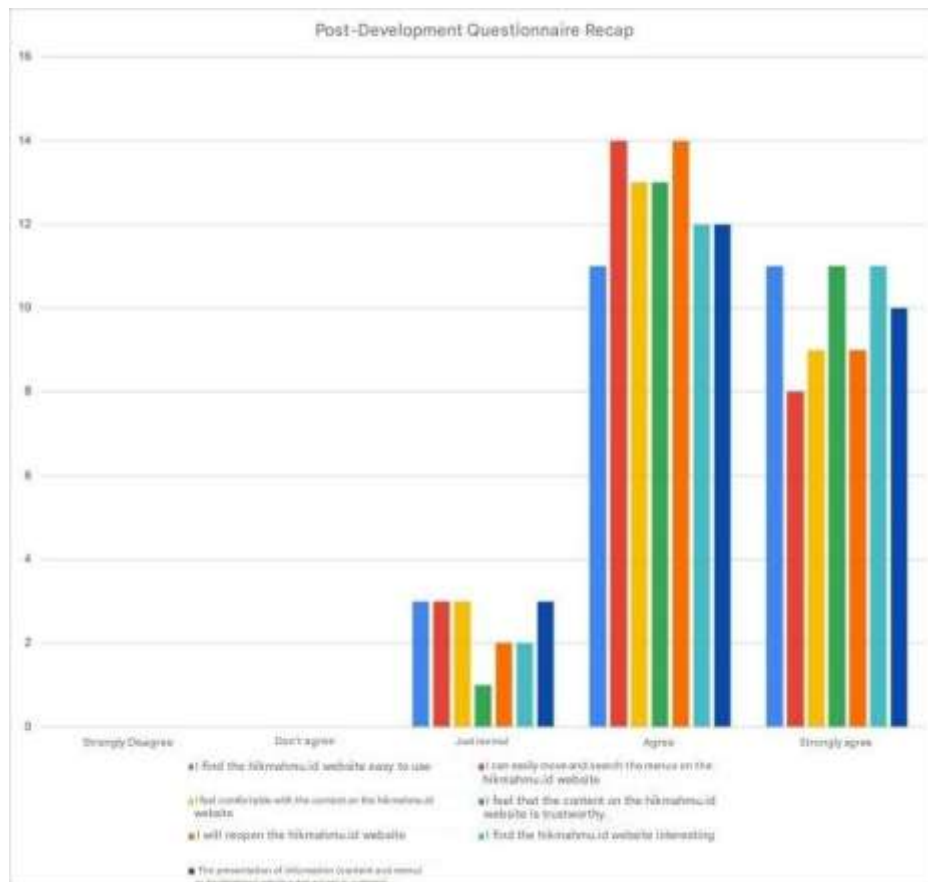
3.10   Test

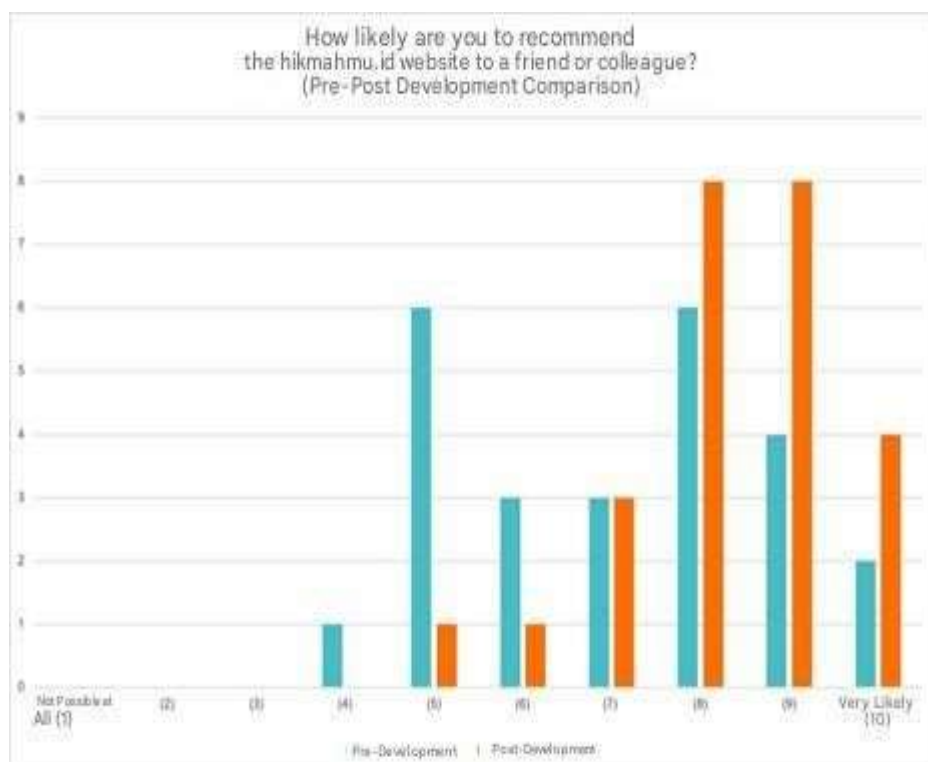**Figure 6. Infographic answers to questions 1-7 after web repair**

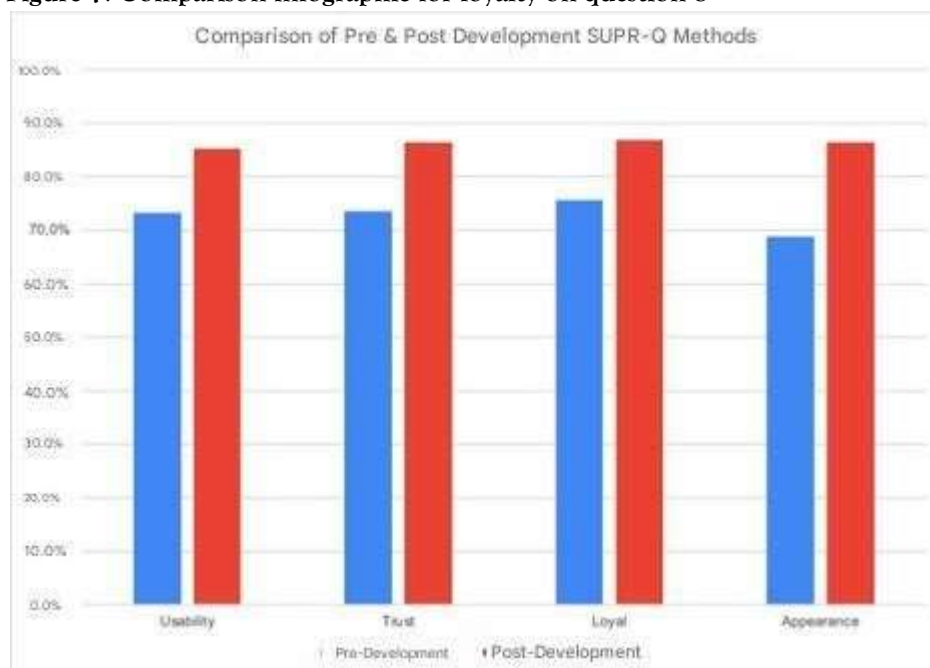**Figure 7. Comparison infographic for loyalty on question 8**

Figure 8. Comparison of Initial Web and Web Development Percentages

Figures 6 and 7 explain that there was a more positive assessment of the respondents towards the new design test, this can be shown by the absence of disapproving assessments of NFS questions, and an increase in scores above 6 on non-NFS questions. This has an impact on 4 aspects of the SUPR-Q assessment which have also increased from the previous Usability of 73.2% to 85%, Trust 73.6% to 87%, Loyalty 75.6% to 87%, Display 68.8% to 85%. Therefore, this research has resulted in a very significant improvement in the appearance of the UI/UX web of deaf da'wah hikmahmu.id.

4. CONCLUSION

The results of this study show that the increase in user experience is shown by growth in certain categories such as the display category showing the largest increase (+17.6%), which may indicate that users are directly and clearly feeling the impact of the change in visual aspects. The increase in trust (+12.8%) and ease of use (+12%) also indicates that the platform is seen as more trustworthy and user-friendly, two important factors that affect loyalty (+11.2%). Overall, these improvements show that the changes made have significantly improved the overall user experience, leading to higher user satisfaction, engagement, and retention.

REFERENCES

[1] Budihardjo. (2007). "Konsep Dakwah Dalam Islam", SUHUF, vol. 19, No 2, pp.89-113

[2] Ismail, SM, Januri. (2023). Hukum Dakwah Dalam Al-Qur'an (Mengkaji Makna Perintah Dakwah Dalam Perspektif Tafsir Maudhu'i)", Jurnal Sosial dan Budaya Syar'i (SALAM) Vol. 10 No. 3 pp. 881-906 UIN Jakarta

[3] Muhammaddin. Kebutuhan Manusia Terhadap Agama, Jurnal. JIA/Juni /Th.XIV/Nomor 1/99-114. 2013.

[4] UNDANG-UNDANG REPUBLIK INDONESIA NOMOR 8 TAHUN 2016 TENTANG PENYANDANG DISABILITAS

[5] K. Dan, R. Dalam, T. Pembelajaran, S. Y. Anugerah, S. Ulfa, and A. Husna. (2020). Pengembangan Video Pembelajaran Bahasa Isyarat Indonesia (Bisindo) Untuk Siswa Tunarungu Di Sekolah Dasar Luar Biasa Article History. JINOTEP, vol. 7, no. 2, pp. 76–85, doi: 10.17977/um031v7i22020p076.

[6] Kemenkes RI. (2019). Disabilitas Tuna Rungu," InfoDATIN Pusat Data dan Informasi Kementerian Keseharan RI, no. ISSN 7452-1449. pp. 1–9.

[7] Muchammad Nasucha, Studi Media dan Agama: Tinjauan Awal, vol. 1, no. 1. 1996.

[8] Atmaja, RJ. (2018). Pendidikan dan Bimbingan Anak Berkebutuhan Khusus. Bandung: Remaja Rosdakarya. hlm. 61 [9] Ulfah, S. M.; Ubaidah, S. (2023). Penerapan Bahasa Isyarat Dalam Pembelajaran Bagi Anak Berkebutuhan Khusus Tuna Rungu. JDSR. Vol. 2. Pp. 29-43.

[10] A. S. Nugraheni, A. P. Husain, and H. Unayah, (2023). Optimalisasi Penggunaan Bahasa Isyarat Dengan Sibi Dan Bisindo Pada Mahasiswa Difabel Tunarungu Di Prodi PGMI UIN Sunan Kalijaga. J. Holistika, vol. 5, no. 1, p. 28, doi: 10.24853/holistika.5.1.28-33.

[11] Pimpinan Pusat Muhammadiyah. (2022). Tanfidz Keputusan Muktamar ke-48 Muhammadiyah. Yogyakarta.

[12] Fahana, J., & Oktavian, W. (2024). RANCANG BANGUN APLIKASI DAKWAH RAMAH DIFABEL TUNARUNGU BERBASIS WEBSITE MENGGUNAKAN METODE AGILE. ZONAsi: Jurnal Sistem Informasi, 6(2), 256 - 272. https://doi.org/10.31849/zn.v6i2.19618

[13]https://informatics.uii.ac.id/2023/04/17/pentingnya-ui-ux-pada-aplikasi-atau- web/ di akses pada 31 Maret 2024.

[14] https://www.interaction-design.org/literature/topics/ui-design di akses pada 31 Maret 2024.

[15] https://www.interaction-design.org/literature/topics/ux-design di akses pada 31 Maret 2024.

[16] Wahid, AF. (2022). Implementasi Metode Design Thinking untuk Validasi IDE STARTUP FIND DOSEN.

[17] Stanford Design School. (2012). The Virtual Crash Cource Playbook. Institute of Design at Stanford.

[18] https://uxpajournal.org/supr-q-a-comprehensive-measure-of-the-quality-of-the-website-user-experience/ di akses pada 24 Juni 2024

[20]   Rudiarta, IW. (2022). Penerapan Teori Hierarki Kebutuhan Maslow Dalam Pembelajaran Daring. WIDYACARYA: Jurnal Pendidikan, Agama Dan Budaya Volume 6. Nomor 1. Pp. 13-23

[21]   Wiratama, SA. (2021). Aktualisasi Diri Penyandang Disabilitas Rungu Wicara dalam Kesenian Angklung di BRSPDSRWM Cipayung Jakarta Timur. Skripsi. UIN Syarif Hidayatullah Jakarta.

[22]   Syafaat M. (2018). Aplikasi Komunikasi Penyandang Tuna Rungu Dengan Metode Speech Recognition Teknologi Berbasis Android. Skripsi. Fakultas Sains Dan Teknologi Universitas Islam Negeri Alauddin Makassar.

[23]   Mandarani, Putri & Putra, Yogi. (2020). Aplikasi Bahasa Isyarat Untuk Tuna Rungu Menggunakan Platform Android. Jurnal TeknoIf. 8. 47. 10.21063/jtif.2020.V8.1.47-52.

[24]   Rahman, F. S., & Yuhefizar, Y. (2017). Aplikasi Virtual Kata Untuk Komunikasi Penyandang Tunarungu Berbasis Android. Jurnal RESTI (Rekayasa Sistem Dan Teknologi Informasi), 1(2), 99 - 105. https://doi.org/10.29207/resti.v1i2.49

[25]   D. A. Rusanty, H. Tolle, and L. Fanani. (2020). "Perancangan User Experience Aplikasi Mobile Lelenesia (Marketplace Penjualan Lele) Menggunakan Metode Design Thinking | Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer," Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer, vol. 3, no. 11, pp. 10484–10493