KLIK: Kajian Ilmiah Informatika dan Komputer
ISSN 2723-3898 (Media Online)
Vol 3, No 6, Juni 2023, Hal 852-860
DOI 10.30865/klik.v3i6.923
https://djournals.com/klik

Re-Design Tryout Wangsit Mobile Apps using Learner Centered Design Method

Firyal Yamiza Akbar, Ati Suci Dian Martha*, Dawam Dwi Jatmiko

School of Computing, Telkom University, Bandung, Indonesia
Email: [1]firyalakbar@student.telkomuniversity.ac.id, [2]aciantha@telkomuniversity.ac.id, [3]dawamdjs@telkomuniversity.ac.id
Correspondence Author Email: aciantha@telkomuniversity.ac.id

Abstract−The many variants of subjects with varying difficulty levels cause some students to have difficulties understanding the material. Some students who find it challenging start attending tutoring provided by teachers or various tutoring centers and purchase practice question books to better grasp the material they haven't mastered. One of the books is the Wangsit learning book. Wangsit is one of the best-selling exercise books among high school 12th students in Indonesia. Wangsit provides a learning aid called the Wangsit tryout mobile application, which serves as an app for conducting practice tests and providing video learning materials. However, there are user interface issues related to the application, such as the placement of several buttons on the tryout page being less than optimal, which requires learners to become more accustomed to it and the score page of the tryout lacks clear information about the test results. Usability measurement was conducted using the System Usability Scale (SUS) with 8 respondents who were 12th-grade students and had Wangsit om Jero's book. The obtained System Usability Scale score was 43.75. This study aims to redesign the interface display of the Tryout Wangsit mobile application to make the Wangsit tryout mobile application suited to the learners' needs by using the learner-centered design method, which focuses on learners' learning experiences. The objective was to improve the usability of the Tryout Wangsit mobile application and align it with learners' needs. The study resulted in a redesigned interface display for the Tryout Wangsit Mobile application using the learner-centered design method. As a result, the application achieved an improved System Usability Scale (SUS) score of 83.12.

Keywords: Learner Centered Design; System Usability Scale; Tryout Mobile Application; User Interface; Wangsit

1. INTRODUCTION

E-learning is the advancement of learning through technology that allows students to attend classes, tests, or exams from anywhere as long as they are connected to a computer network [1]. Tutoring center is a guidance field aimed at helping students recognize, nurture, and develop themselves, cultivate good study habits to master knowledge and skills, and prepare them for further education at higher levels [2].

Wangsit is one of the best selling books among high school 12th students in Indonesia, written by Mr. Muamar Khadafi [3]. It began with the establishment of a tutoring center in 2012, where the book unexpectedly proved effective in helping students pass the national college entrance exams [3]. The book was published for the general public in 2013 [3]. The Wangsit book contains a collection of questions and strategies to face national college entrance exams, computer-based selection tests (UTBK), and independent entrance exams for universities [3]. In 2017, Wangsit started using Google Forms to conduct tryouts, and in 2019, it further developed by utilizing the services of a developer from Bandung to create a tryout application [3]. The Wangsit tryout application features various functions such as allowing students to access video explanations of the material and take practice tests.

To determine the level of usability of the Wangsit tryout application, usability measurements were conducted using the system Usability Scale (SUS) on 8 respondents who were 12th-grade students who have the Wangsit book. The system Usability Scale (SUS) was chosen because it has been proven effective in detecting differences in smaller sample sizes compared to other questionnaires [4]. The obtained SUS score was 43.75, indicating that the Wangsit tryout application scored below the average score for good usability, which is above 68 [4]. The acceptability range fell into the "not acceptable" category, the grade scale was rated as "F," and the adjective ratings were within the "ok" range.

In addition to the SUS score, observations and interviews were conducted to gain deeper insights into the interface issues experienced by the respondents who using the Wangsit Tryout mobile application. The observations and interviews revealed several interface problems experienced by learners, such as "Selesai" buttons on the tryout page being positioned inappropriately that makes requiring learners to adapt more longer, and for the score section, the explanation about information results of the completed tryouts is not clear enough.

Based on the above issues, it is necessary to redesign the interface of the Wangsit tryout application. The method to be used for the redesign process is the learner-centered design method, which aims to help learners achieve their goals in the learning process [5]. This method is expected to address the usability problems experienced by learners because it focuses on the learners, allowing them to contribute ideas and express their needs regarding the interface design to facilitate the learning process [6].

After the interface redesign, another round of usability testing will be conducted to measure learnability, efficiency, memorability, errors, and satisfaction [7]. In-depth interviews and usability measurements using the system usability scale (SUS) will be conducted for this purpose. The 10 questions of SUS questionnaire can comprehensively measure learnability and usability, with questions 4 and question 10 specifically measuring learnability, and the remaining 8 questions assessing usability [8].

The research has several limitations to ensure efficient and accurate results. Firstly, the user sample for the application consists of high school students from the 12th grade of the 2022 batch who use Android-based smartphones

and Wangsit om Jero's book. Secondly, the focus of this research is on redesigning the tryout and score tryout pages. Thirdly, the usability measurement of the redesigned interface of the Wangsit tryout application will be conducted using the system usability scale (SUS), aiming to achieve a score above 68 (indicating a good SUS score). The objectives of this research, based on the stated problem formulation, are to redesign the interface of the Tryout Wangsit mobile application to meet learner needs using the learner-centered design method and to analyze the usability results of the redesigned interface when it reaches a SUS score of 68.

In the study about Supporting Learning in Context: Extending Learner-centered Design to the Development of Handheld Educational Software by Kathleen Luchini, William Bobrowsky, Mike Curtis, Chris Quintana, and Elliot Soloway [9] provides that learner-centered design can support mobile educational software for maximize its potential to support learning activities anytime and anywhere. In the study about Design Approach for e-learning systems: Should it be User-Centered or Learner-centered by Debayan Dhar, Pradeep Yammiyavar [5] provides that learner-centered design is more effective than user-centered design for making the interface of e-learning apps. There are several differences between LCD and UCD, including differences in focus, goals, domain knowledge, characteristics, approach, and target. In the study about An Indonesian Adaptation of the system usability scale (SUS) by Zahra Sharfina, and Harry Budi Santoso [10] proved that the SUS question already translated into the Indonesian language helped the respondent to understand the question easier and the system usability scale (SUS) can be used by usability practitioners with different cultures to evaluate usability and research goals. In the study about System Usability Scale vs Heuristic Evaluation: A Review by Usman Ependi, Tri Basuki Kurniawan, and Febriyanti Panjaitan [11] proved that the System Usability Scale (SUS) has a testing scale that is easily understood by respondents. It can be conducted with a small sample size while still producing reliable results. Moreover, it can effectively distinguish between software that is usable and not usable. In the study about Identification of Learning Experience in Online Learning with User Persona Techniques Based on Learner-Centered Design Concept by Putu Yudia and I Gede Sudirtha [12] provides creating user personas based on the learner-centered design concept can be used to explore more detailed data related to users' needs when engaging in online learning according to their needs and expectations.

The objectives of this research are to improve the usability of the Tryout Wangsit mobile, redesigning the user interface of the Tryout Wangsit application to align with the learners' needs using the learner-centered design method, and analyze the usability results of the redesigned user interface of the Tryout Wangsit application once it achieves a SUS score of 68.

2. RESEARCH METHODOLOGY

2.1 Data Collction

Data collection is conducted on these 8 learners through interviews and direct observations, both in-person to understand their specific issues, needs, and expectations for the new interface design of the Tryout Wangsit mobile application.

The usability evaluation of the Tryout Wangsit mobile application is performed using the system usability scale with 8 respondents who have Wangsit om Jero's books. According to J. Brooke [8], the System Usability Scale has several advantages for measuring the usability of a system, such as: system usability scale can be easily used as the results are presented in a numerical score ranging from 0 to 100, system usability scale does not require complex calculations, system usability scale can be used free of charge without any additional costs, and system usability scale has been proven to be valid and reliable, even when using small sample sizes.

The obtained SUS score was 43.75, indicating that the Wangsit tryout application scored below the average score for good usability, which is above 68 [4]. Based on the categorization the acceptability range fell into the "not acceptable" category, the grade scale was rated as "F," and the adjective ratings were within the "ok" range.

2.2 Research Stages

In this research stage, it describes the stage that will be conducted during the study. This research utilizes the learner-centered design method, which consists of stages adapted from the user-centered design method. As shown in Figure 1.

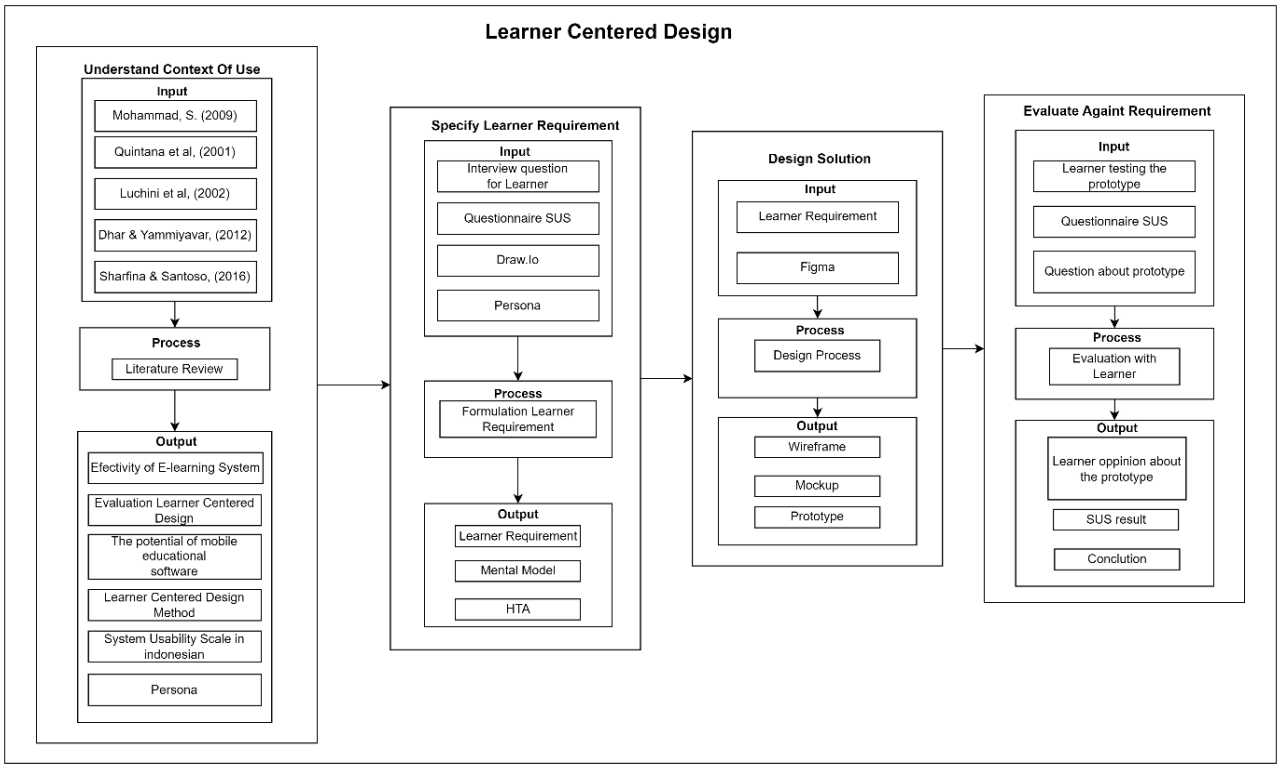

Figure 1. Research Stage

2.3 Understand Context of Use

The activity carried out in understand context of use is to analyze the results of interviews and observations that conducted with 8 learners in the form of personas.

2.3.1 User Persona

User persona is a tool aimed to understanding a person's target group and assisting in decision-making to make features, products, website navigation, and even social media interactions more user-friendly. User persona consists of a set of relevant data about the user, such as name, age, occupation, personality, goals, barriers, and needs [13].

Table 1. Persona

Demographic	Goals	Pain Points	Motivation	Needs
Age: 17-18 years old	Easy comprehension of the material to confidently tackle all UTBK questions	Application interface that is less understandable when first used	Ease of use when working on tryouts	Simple application interface that is easy to understand
Occupation: 12th-grade high school student	Smooth functioning	Inadequate information provided by the score display	Obtaining more informative information about the tryout results, makes it easier to understand the outcomes.	Proper placement of buttons for easy navigation
Hobbies: Learning, walking, playing music, painting, reading books, cooking, going out, listening to music	The application without errors comprehensive features	Insufficiently detailed and sometimes unavailable question explanations.		Visually appealing and engaging interface
Characteristics: Able to understand others' feelings, a good listener, detail-oriented, confident, sociable, enjoys challenges, cheerful, friendly,				Detailed and informative explanation of tryout results

enjoys storytelling, expressive	
Learning style: Visual and audiovisual.	

2.4 Specify Learner Requirement

In this phase, the aim is to identify the learner's problems and needs, including goal and requirement identification, mental model design, and HTA (Hierarchical Task Analysis).

2.4.1 Goal and Requirement

After creating the persona, the next step is to determine the goals and requirements, which are necessary to fulfill the respondent's objectives, and to identify which aspects require redesign according to the respondent's feedback. As shown in Table 2

Table 2. Goals and Requirements

Goals	Requirements
Comfortable experience while taking the tryout by being able to view the time taken, adjust the font size for questions and answers.	Re-designing the layout of the tryout page such as changing the color of the buttons and adding a background for the questions and answers.
Being able to view answered questions and submit answers when all questions have been completed or when the respondent feels they have done enough.	
Being able to proceed to the next question without accidentally pressing the "Selesai" button.	Moving the position of the "Selesai" button to prevent accidental pressing, as it is often located near the "next" button in other learning applications.
Obtaining clearer information about the score results of the completed tryout, making it easier to understand.	Redesigning the "score" page with a more informative design.

After that, the process continues with creating the mental model and Hierarchical Task Analysis (HTA).

2.4.2 Mental Model

A mental model is what users believe and know about how to use a given system [14]. It is based on their beliefs rather than factual information, meaning it represents a user's understanding of the system based on their thoughts [14]. There are two mental models in this reaserch, tryout and tryout score, which provide an overall representation of when learners want to take a tryout and sees the score results. For the mental models, it can be seen in Figure 2.

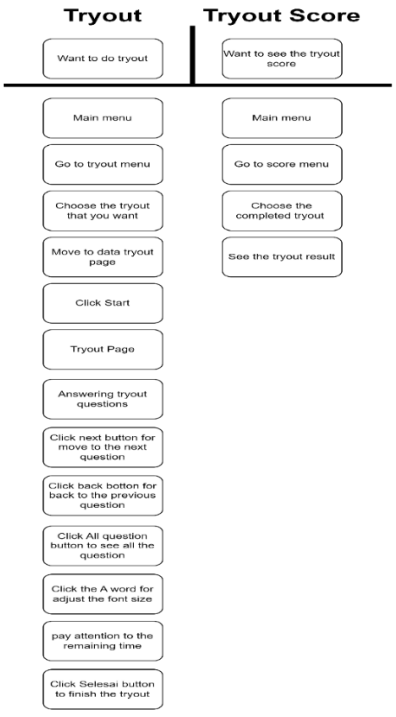

Figure 2. Mental Model

As we can see in Figure 2, On the left side is mental model of tryout and on the right side is a mental model of the score tryout. For the tryout this section contains the overall representation when learner want to take a tryout, start from main menu until click "selesai" button to finish the tryout. For tryout score this section contains the overall representation when learner want to see the tryout score, start from main menu until see the tryout result.

2.4.3 Hierarchical Task Analysis (HTA).

Hierarchical Task Analysis (HTA) is a method that can be used to communicate the process followed by users to others, as well as serve as a starting point for further assessment [15]. HTA is also a systematic method that describes the organized workings to achieve the goals of a task, starting with the top-down identification of overall task goals, and allows for focusing on important aspects of a task [16]. There are two ways to represent HTA: through diagrams and model tables. Diagrams are easier to use as they allow for adding detailed information about each task [16]. There are two Hierarchical Task Analysis (HTA) for this research, Tryout and Score Tryout, which consist of systematic steps or processes to perform the tryout and view the score results. For the HTA of the Tryout menu and Score tryout, it can be seen in Figure 3 and Figure 4.

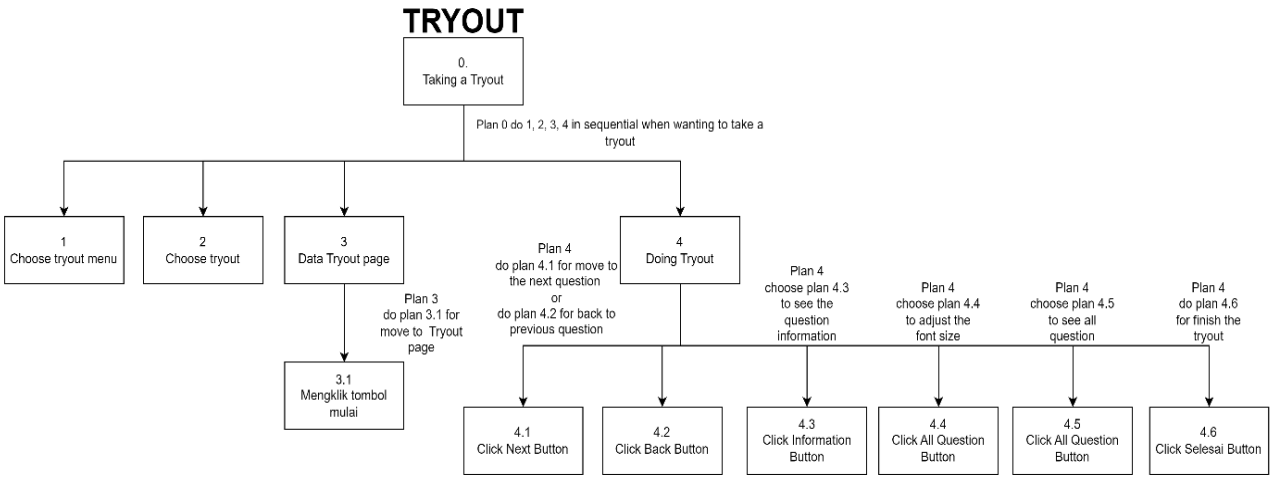

Figure 3. Tryout HTA

As we can see in Figure 3, Tryout HTA contains the steps to perform the tryout, starting from choosing the tryout menu until click the "selesai" button to finish the tryout.

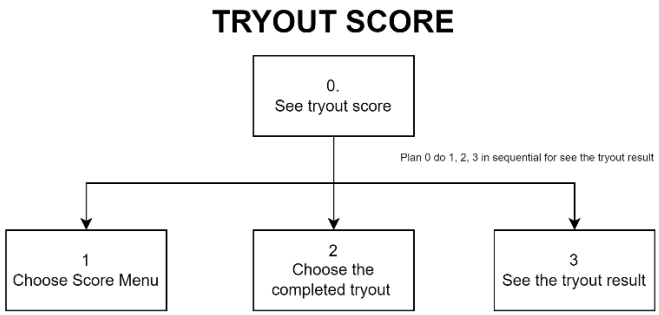

Figure 4. Tryout Score HTA

As we can see in Figure 4, Tryout Score HTA contains the steps to see the tryout result, starting from choosing the score menu, choose the completed tryout, and see the tryout result.

2.5 Design Solution

The design solution is a continuation of the specify learner requirements stage with the aim of designing solutions for the known problems and needs of the learners. There are several activities in design solution such as designing wireframes which are initial designs that illustrate the elements on the page, then creating mockups where visual design aspects such as color choices start to be determined, and making prototypes.

2.6 Evaluate Againt Requirement

In this phase, an evaluation is conducted on the new interface design that has been created. The aim is to know if the design that has been created is already the same with the learner's goals, and needs, or not. There are several activities in this phase such as testing, usability evaluation, and analysis the result.

3. RESULT AND DISCUSSION

3.1 Wireframe

Wireframe is a concept of page layout that establishes what kind of interface element, content, and functionality a user needs [17]. The focus of a wireframe is to give an early understanding of a visual page in a project [17]. Wireframe is able to create global and secondary navigation to make sure the terminology and structure used for the site attain the user's expectations [17]. Wireframes can be classified into the following three, such low fidelity, mid fidelity, and high fidelity [17].

For creating wireframes of the Tryout and Score Tryout pages based on the goals and requirements, and learner needs obtained, the author also asked the learners if there are any learning applications they frequently use. The wireframe of the Tryout page and Score tryout page that has been created, it can be seen in Figure 5.

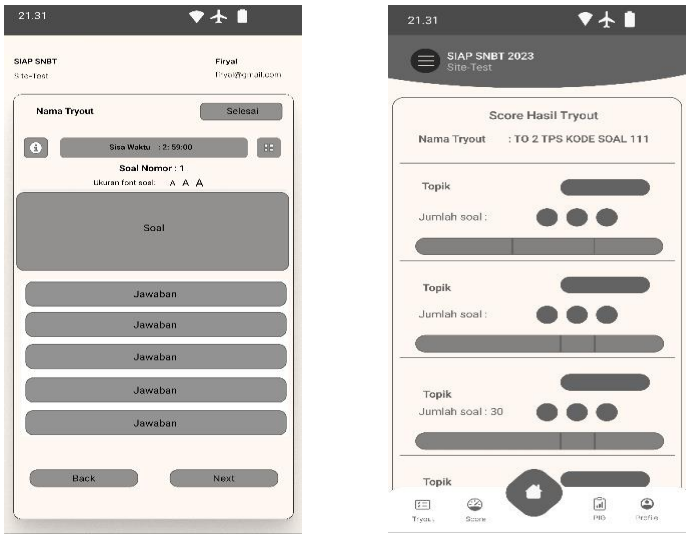

Figure 5. Wireframe of Tryout page and Score tryout after the redesign

On the left side is a wireframe of the tryout page and on the right side is a wireframe of the score tryout page. For the tryout page, this section changes the position of the "Selesai" button, in the previous design "selesai" button is located beside the "next" button which makes learners often miss clicking because the position was similar like the "Next" button commonly found in another learning applications. For the score tryout, this section adds the tested material.

3.2 Mockup

Mockup is like a wireframe but it's more detailed, and a mockup is what your user experience and final project appearance will look like [18]. Mockup aims to demonstrate the content layout, fonts, colors, and icons of the product design [18]. The are several benefits of mockups such as realistic, easily revised, and convincing [18]. There are several tools that can be can use to create mockups such as figma, balsamiq, mock flow, etc [19]. For the mockup of the Tryout page and Score tryout page that has been created, it can be seen in Figure 6.

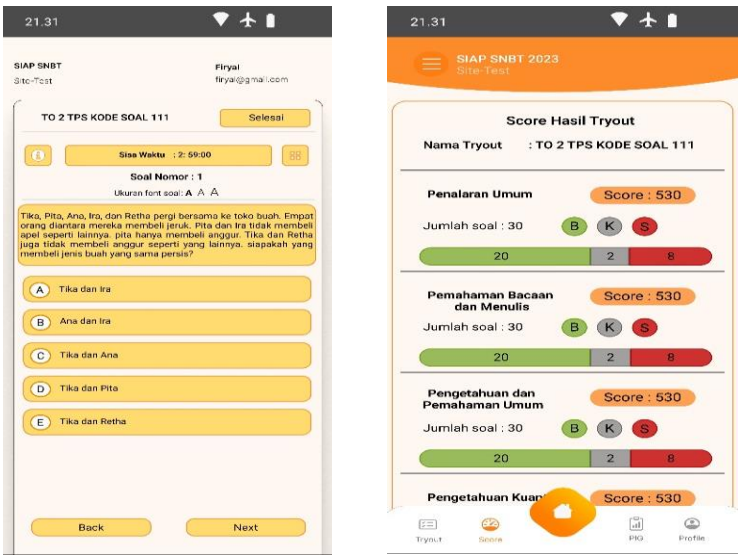

Figure 6. Mockup of Tryout page and Score tryout after redesign

On the left side is mockup of the tryout page and on the right side is a mockup of the score tryout page. For the tryout page this section contains a tryout duration, “information” button, “all question” button, the number of questions, the question, the answer, back button, next button, and “Selesai” button. One of the things that make it different from the previous design is the location of “Selesai” button, in the previous design “Selesai” button is located beside the “next” button which make learner often missclick. For the score tryout page contains the name of tryout, the tested material such as “Penalaran Umum”, “Pemahaman Bacaan dan Menulis”, “Pengetahuan dan Pemahaman Umum”, “Pengetahuan Kuantitatif”, “Bahasa Inggris”, “Bahasa Indonesia”, and “Pengetahuan”, explanation of the answer such as green for the correct answer, red for the wrong answer, and grey for the question that not answered, the score for each material, and total number of questions. The detailed mockup, it can be seen in appendix.

3.3 Prototype

Prototype and mockup are two different things. Prototype is clickable and it can demonstrate the behavior of the app, mockup is static and it just presents the way it looks [18]. At this stage, the prototype demonstrates how users will interact with the new interface of Tryout Wangsit mobile application based on the previous mockup that has been created. For the detailed prototype it can be seen in the appendix.

3.4 Evaluation and Testing

Evaluation is the next process after creating the prototype. The evaluation was perfomed by testing the working prototype of the new interface design Tryout Wangsit mobile application with 8 respondents using the system usability scale (SUS) questionnaire. System Usability Scale (SUS) questionnaire consisting of 10 questions is used. These questions can comprehensively measure learnability and usability. To measure learnability, questions 4 and 10 are used, while the remaining 8 questions are used to measure overall usability[8]. This evaluation is aimed to prove the impact of using learner-centered design method on improving the usability of Tryout Wangsit mobile application and also to check if the new interface design of tryout wangsit mobile application is based on the learner’s needs. The testing is performed on the same 8 learners, who are 12th-grade students and have the Wangsit om Jero’s book. They asked to do some testing on the prototype in figma that can be accessed on each learner’s android mobile device to experience the different between the previous interface and the new interface of Tryout page and Score Tryout page. After learner completed to try the new interface of tryout page and score tryout page, they asked to complete the system usability scale (SUS) questionnaire that already translated into Indonesian language by using a google form. This SUS method consists of 10 questions and 5 answer options. The answer options are on a scale of 1 to 5, where “1” means "Strongly Disagree" and “5” means "Strongly Agree". The 10 SUS question that already translated into Indonesian language [20] shown in Table 3

Table 3. list of questions for the System Usability Scale (SUS) questionnaire [20]

No	Pertanyaan
1	Saya berpikir akan menggunakan sistem ini lagi.
2	Saya merasa sistem ini rumit untuk digunakan.
3	Saya merasa sistem ini mudah untuk digunakan.
4	Saya membutuhkan bantuan dari orang lain atau teknisi dalam menggunakan sistem ini.
5	Saya merasa fitur-fitur sistem ini berjalan dengan semestinya.
6	Saya merasa ada banyak hal yang tidak konsisten (tidak serasi) pada sistem ini.
7	Saya merasa orang lain akan memahami cara menggunakan sistem ini dengan cepat.
8	Saya merasa sistem ini membingungkan.
9	Saya merasa tidak ada hambatan dalam menggunakan sistem ini.
10	Saya perlu membiasakan diri terlebih dahulu sebelum menggunakan sistem ini.

In calculating the System Usability Scale (SUS) score also have specific rules to follow. Here are the rules for scoring the system usability scale (SUS) questionnaire [20]: For odd-numbered questions subtract 1 from the score obtained from the user's response, for even-numbered questions the final score is obtained by subtracting the user's response score from 5, and the SUS score is calculated by summing the scores of each question and then multiplying the total by 2.5.

3.5 Testing Result

Comparing between the SUS score of the previous design and the new design that has been created based on learner centered design (LCD) method. The SUS score obtained was 83.12. This indicates an improvement compared to the previous SUS score of 43.75, which has increased to 83.12, meaning that the Tryout Wangsit mobile application is now above the average good SUS score, which is more than 68. The acceptability range, which was previously classified as not acceptable, has changed to acceptable. The grade scale, which was previously categorized as "F," has changed to "B," and the adjective ratings, which previously fell within the "ok" range, have changed to "excellent.". There has been an improvement for each item of the SUS questionnaire, from question 1 to question 10. This is due to the layout of the tryout page and the tryout score page meeting the learner's expectations. It shown in Table 4 and Figure 7.

Table 4. SUS Score before and after redesign

Question	Before Redesign Score	After Redesign Score
Question 1	16	25
Question 2	14	28
Question 3	18	28
Question 4	8	26
Question 5	18	27
Question 6	13	28
Question 7	18	27
Question 8	15	29
Question 9	18	28
Question 10	2	20
SUS Score	43,75	83,12

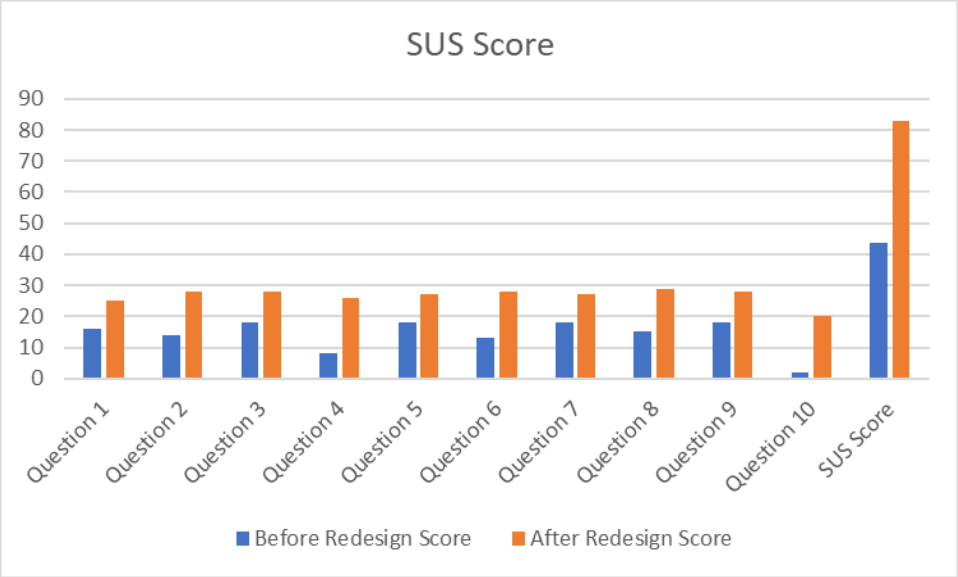

Figure 7. SUS Score before and after redesign

As we can see in Table 4 and Figure 7, each of the answers for the SUS questionnaire experienced an improvement. For the first question, the score increased from 16 to 25. This improvement was due because respondents feel will use it more frequently the system again compared to before because the new interface has a simple and user-friendly interface. In the second question, the score increased from 14 to 28, This improvement was due because respondents feels the new interface is less complicated compared to the previous one. The third question, the score increased from 18 to 28, This improvement was due because respondents feels the new system easier to use compared to the previous one. The fourth question showed a significant increase where the score changed from 8 to 28. This improvement was due because respondents feels they no longer needed assistance from others to use the new interface compared to the pevious one. For the fifth question, the score increased from 18 to 27, that's mean that respondents feels that the features of the new interface functioned properly compared to the previous one. The sixth question the score increased from 13 to 28, indicating that respondents perceived a higher level of consistency in the new interface compared to the previous one. The seventh question, initially scoring 18, increased to 27, This improvement was due because respondents believed that others would understand how to use the new interface more quickly compared to the previous one. For the eighth question, the score increased from 15 to 29, This improvement was due because that respondents feel the new system was less confusing compared to the previous one. The ninth question, the score increased from 18 to 28, indicating that respondents perceived fewer obstacles when using the new system compared to the previous one. For the tenth question, the score increased significantly from 2 to 20, that's means the respondents feels they need to familiarize themselves with the system but found it less challenging than the previous one.

4. CONCLUSION

Based on the research and analysis conducted, it can be concluded that the learner-centered design method is one of the methods that can be used for designing the interface of a learning application. It can be seen from the improvement in the usability scale score of the Tryout Wangsit Mobile application from 43.75 to 83.12, which means that it has surpassed the minimum average SUS score considered good, which is more than 68. Additionally, there have been changes in the acceptability ranges, which previously were classified as not acceptable and now have become acceptable. The grade

scale, which previously was categorized as "F," has changed to "B," and the adjective ratings, which previously fell within the "ok" range, have changed to "excellent". Furthermore, by utilizing the LCD method, it has been proven that it can improve the SUS results. Learner centered design focus on prioritizing the learner's experience during the learning activities. The design of the Tryout Wangsit was also based on the learners' needs, which led to changes in the position of the "Selesai" button previously, learners had complained about miss clicking it since its position was similar to the "Next" button commonly found in another learning applications. Additionally, a redesign was conducted on the tryout score page, which had previously received complaints about lacking clear information provision. For future research, the learner-centered design method can be used again. However, it is important to note that finding references related to the learner-centered design method can be quite difficult, and the average references available are more than 3-5 years.

REFERENCES

[1] Hanum, L. (2019). Analisis Model Penilaian Otentik Pada Pembelajaran Teori Graf Dengan Menggunakan E-learning Edmodo dan Dampaknya Pada Pemecahan Masalah. Available: https://eprints.umm.ac.id/52019/

[2] Kurniawati, T. &. (2022). Pengaruh Bimbingan Belajar Terhadap Prestasi Belajar Siswa Kelas V Di Sekolah Dasar (SD) Negeri 1 Mundakjaya, Kabupaten Indramayu. Available: http://repository.upy.ac.id/id/eprint/3620

[3] Wawancara sejarah berdirinya Wangsit om Jero (2023)

[4] Jeff Sauro. (2011, February 3). Measuring Usability with the System Usability Scale (SUS). Available: https://measuringu.com/sus/

[5] Design approach for E-learning systems: Should it be user centered or learner centered. Proceedings - 2012 IEEE 4th International Conference on Technology for Education, T4E 2012, 239–240. Available: https://doi.org/10.1109/T4E.2012.57

[6] Shift (2014). https://www.shiftelearning.com/blog/bid/345394/4-steps-to-becoming-a-learner-centered-elearning-professional

[7] Aditya Febrianti, D., Hadi Wijoyo, S., & Muslimah Az-Zahra, H. (2019). Evaluasi Usability Web UniPin dengan Menggunakan Metode Usability Testing (Vol. 3, Issue 11). http://j-ptiik.ub.ac.id

[8] Brooke, J. (2013). SUS: A Retrospective (Vol. 8). Available: https://www.researchgate.net/publication/285811057_SUS_a_retrospective

[9] Luchini, K., Bobrowsky, W., Curtis, M., Quintana, C., & Soloway, E. (2002) Supporting learning in context: extending learner-centered design to the development of handheld educational software. Proceedings. IEEE International Workshop on Wireless and Mobile Technologies in Education, 107–111. Available: https://doi.org/10.1109/WMTE.2002.1039230

[10] An Indonesian adaptation of the System Usability Scale (SUS). 2016 International Conference on Advanced Computer Science and Information Systems (ICACSIS), 145–148. https://doi.org/10.1109/ICACSIS.2016.7872776

[11] Ependi, U., Kurniawan, T. B., & Panjaitan, F. (2019). SYSTEM USABILITY SCALE VS HEURISTIC EVALUATION: A REVIEW. Jurnal SIMETRIS, 10(1). https://jurnal.umk.ac.id/index.php/simet/article/view/2725/1654

[12] Pratiwi, P. Y., & Sudirtha, I. G. (2022). SISTEMASI: Jurnal Sistem Informasi Identification of Learning Experience in Online Learning with User Persona Techniques Based on Learner-Centered Design Concepts. http://sistemasi.ftik.unisi.ac.id/index.php/stmsi/article/view/1763

[13] Federal Ministry of Education and Research. (2018). *Personas: How to Create Personas with Secondary Data*. https://repository.dinamika.ac.id/id/eprint/5237/1/16410100061-2020-UNIVERSITASDINAMIKA.pdf

[14] Nielsen Jakob. (2010, October 17). Mental Models. https://www.nngroup.com/articles/mental-models/

[15] Rosala, M. (2020), September 20). Task Analysis: Support Users in Achieving Their Goals. https://www.nngroup.com/articles/task-analysis/

[16] Embrey, D. (2019). Task Analysis Techniques. In A Guide To Task Analysis. CRC Press. https://www.semanticscholar.org/paper/Task-Analysis-Techniques-Embrey/37a877604d6b7e6ee41ca63eb8cbf4a921e276aa

[17] Uzayr, S. (2022). Mastering UI Mockup and Frameworks (Uzayr Sufyan, Ed.; First edition). CRC Press. https://doi.org/https://doi.org/10.1201/b22860

[18] Pleten Oksana. (2019, October 22). What Is a Mockup and Why Do We Need It. https://keenethics.com/blog/1521631041972-the-importance-of-mockups

[19] Kitabee. (2022, August 12). 16 Best Website Mockup Tools for every Professional. https://www.browserstack.com/guide/top-website-mockup-tools

[20] Susilo, E. (2019, March 7). Cara Menggunakan System Usability Scale (SUS) Pada Evaluasi Usability. https://www.edisusilo.com/cara-menggunakan-system-usability-scale/#google_vignette