Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2023
DOI : https://doi.org/10.33395/sinkron.v8i2.12383
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Usability Evaluation of Mobile Interactive Result Checking System using System Usability Score

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Submitted : Apr 11, 2023 | **Accepted** : May 3, 2023 | **Published** : May 7, 2023

Abstract: Mobile phones, especially smartphones have impacted the way we access information related to education. For instance, students are now able to view their results using a smartphone on a browser. However, these result systems that make it possible for students to view their exam results through web browsers or emails on their mobile devices need an internet connection for the process to work as expected. Also, given the indigent nature of most students in developing countries, this creates a digital divide for students that do not own smartphones. With many students coming from rural and often low economic status homes, not many can afford smartphones. Hence, leveraging on the potentials of Unstructured Supplementary Service Data (USSD) and Short Message Service (SMS), a Mobile USSD-SMS Interactive Result Checking System for Resource-Constrained Settings (MIRCS) was developed to provide a device agnostic accessible Result Checking System. This study evaluated MIRCS using System Usability Scale (SUS) to verify the effectiveness from a usability point of view. The result of the evaluation shows that the MIRCS is usable which received grade C (66.21), although it does not meet the acceptable level specified by SUS. Further analysis of the interaction with respondents suggests some areas of improvement to include cost of service, high availability and accuracy.
Keywords: SMS, USSD, SUS, Evaluation, Higher Education.

INTRODUCTION

Mobile devices today are able to support a wide range of technologies and provide users with a variety of services, such as Short Messaging Service (SMS), voice and video calls, web browsing, and a lot more. The number of adults who own multiple mobile devices has increased dramatically in recent years (Cropmton & Burke, 2018), the number of mobile devices is expected to reach 18.22 billion by 2025, an increase of 4.2 billion devices compared to 2020 (Laricchia, 2023). Education has grown stronger because of the internet, SMS, and mobile technology. E-learning platforms, online research, and mobile learning are now more accessible and efficient for students' kudos to these technologies. By offering immediate notification of exam results, a practical method of reaching out to students, and a private way for students to access their results, SMS has also played a significant role in the education sector. For instance, teachers can use SMS to communicate updates about events in the classroom or reminders about assignments. Anyiam et al. (2020) investigated the problems with result processing and checking that Nigeria's public universities are currently having and put in place an improved online system for processing and verifying student results. The system has improved information quality, speed, security, and other factors. Schools and universities can use SMS to send instant notifications to students about their exam results as soon as they are published. This can help to protect their privacy and prevent unauthorised access to their results. SMS is accessible to all students, including those who may not have access to the internet or other forms of technology. This makes it an inclusive way to provide students with access to their exam results.

However, there exist various barriers that restrict the integration of these technologies for institutional purposes in developing countries (Vikram & Timothy, 2018). These hindrances encompass, but are not restricted to, network infrastructure, coverage areas, user financial capacity, technological proficiency, poverty, and among other barriers. As an example, the result system that makes it simple for students to receive exam results via email on their mobile devices needs a steady internet connection. The SMS, however, is a standard feature on all phones. Poon et al. (2019) created a quiz-based intervention to help secondary school students in Cameroon with exam practice. The simplicity of usage, adaptability, and independence from the internet are all benefits of SMS for

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users. Similarly, all phones including feature phones and smartphones are able to access and use the Unstructured Supplementary Service Data (USSD) without the need for the internet. The combined benefit of SMS and USSD are thus more universal than services that require internet connections which exclude feature phone users for instance. Hence, Kawu, et al. (2020) developed a SMS-USSD system for result checking, which they referred to as Mobile USSD-SMS Interactive Result Checking System for Resource-Constrained Settings (MIRCS), aimed at leveraging these advantages.

Software evaluation is the process of evaluating the suitability, performance, and quality of a software application/system. The right approach must be chosen based on the specifications of the software and the evaluation criteria because there are numerous methods, tools, and frameworks (such as Software Evaluation Framework) available for evaluating software. The aforementioned software evaluation has limited considerations for users. Hence, the human-centered evaluation as proposed by Neilson (2012) when he discussed software usability. A key reference in his definition of usability is user satisfaction.

In order to make recommendations and suggestions for improvement, the primary motivation behind this research is to evaluate MIRCS's usability from the perspective of the student. In this study, the usability of MIRCS is evaluated using the System Usability Scale (SUS).

LITERATURE REVIEW

Usability

Building an education service that makes use of the features that are available on all mobile devices is not sufficient; usability should also be taken into account. Before putting educational technology to larger use, stakeholders who are considering its implementation should evaluate it. To evaluate developed technology systems, there are human-computer interaction (HCI) methodologies available. Usability, according to Nielsen (2012), is "a quality attribute" (his emphasis) that evaluates how user-friendly user interfaces are. He described the five (5) quality components of learnability, efficiency, memorability, errors, and satisfaction to define usability. Learnability gauges how easy it is for users to carry out fundamental tasks when they first encounter the design. Efficiency measures how quickly users can complete tasks once they become accustomed to the design. When a design is revisited after a period of inactivity, a user's ability to quickly regain proficiency is measured by its memorability. Error refers to how frequently users make mistakes, how serious these mistakes are, and how quickly they are able to correct their mistakes. Satisfaction measures how pleasant a design is to the users.

Usability testing

Usability testing is the process of assessing a product or service by having users try it out while being observed (Usability.gov, n.d). A researcher asks participants to perform tasks, usually one or more specific user interfaces while the researcher takes notes (Moran, 2019). Once an application is released, it is important to conduct a usability assessment to determine its effectiveness, efficiency, and user satisfaction. This assessment can identify any potential obstacles that users may encounter and the feedback obtained can be used as a reference point to enhance the application's performance and make it better in the future (Ratnawatiet al., 2020). There are several questionnaires that can be used in usability testing as suggested by Sauro & Lewis (2016), among others:

1. System Usability Scale (SUS). The System Usability Scale (SUS) is a straightforward, ten-item scale that provides a broad perspective of subjective evaluations of usability (Brooke, 1996). Given that it is quicker and less expensive, it is a good method for evaluating the usability of any system.
2. Questionnaire for User Interface Satisfaction (QUIS). The tool was created by a multidisciplinary research team at the University of Maryland (Harper & Norman, 1993). The QUIS was created to evaluate how satisfied users felt with particular features of the human-computer interface.
3. Post Study System Usability Questionnaire (PSSUQ). The PSSUQ is a 19-item questionnaire created to measure users' perceptions of their satisfaction with their computer systems. Its origins are in a Suzanne Henry-led internal IBM project from the late 1980s called SUMS (System Usability Metrics) (Lewis, 2002). Participants can provide an overall assessment of the system they used by completing the PSSUQ (Lewis, 1995).
4. Software Usability Measurement Inventory (SUMI). The 50-item SUMI questionnaire was created in accordance with psychometric best practices to address the persistent issue of evaluating software usability from the viewpoint of users. It provides a dependable and accurate method for comparing related software products and different versions of the same product, as well as diagnostic data for future developments (Kirakowski & Corbett, 1993).

System Usability Scale (SUS)

Brooke (1996) defined System Usability Scale (SUS) as a simple, ten-item scale giving a global view of subjective assessments of usability. SUS was developed in 1996 for the evaluation of perceived usability, but it took several years in the design of educational technology systems to adopt it (Vlachogianni & Tselios, 2022). The

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SUS has evolved from its modest origins to become an important instrument in the toolkits of researchers and practitioners of usability and user experience (Lewis, 2018). The tool asks users to rate how much they agree or disagree with the 10 statements provided about the software being evaluated, half of which are positive and the other half are negative. According to Lewis (2018) the tool used a scoring template to obtain the reporting results. The scoring template is designed to change the original survey scores provided by various users of a specific software program into a SUS score, using Brooke's standard scoring method. The method involves standardizing the statement ratings to a 0-4 scale and then multiplying the total by 2.5, resulting in a score between 0 and 100. In their evaluation of a VLE platform used in a higher education environment using SUS, Abuhlfaia & Quincey (2019) discovered that it performed below the average usability expectation. According to the results of the tests conducted to 101 respondents, the SUS score is 62.52, which is lower than the average usability expectation. The VLE evaluated had passable usability levels, but the study has shown that these levels are below the average level as defined by the SUS, with some significant usability issues highlighted by the free-text responses. In Supriyadi et al. (2020) evaluated the usability level of the ITTP e-learning system using the System Usability Scale. The system test with 100 users yields a SUS score of 55.3, indicating that the system's acceptability level is in the marginal low range thus, making it FAIR/OK and suitable for use.

METHOD

In this study, we use the Software Usability Scale to evaluate the usability of the Mobile Interactive Result Checking System (MIRCS) system created by Kawu et al (2020). A Google Forms online form was used to host a survey based on the System Usability Scale. A link to a questionnaire was sent to various departmental Whatsapp group chats of Ibrahim Badamasi Babangida University students in order to recruit participants (see Figure 1).

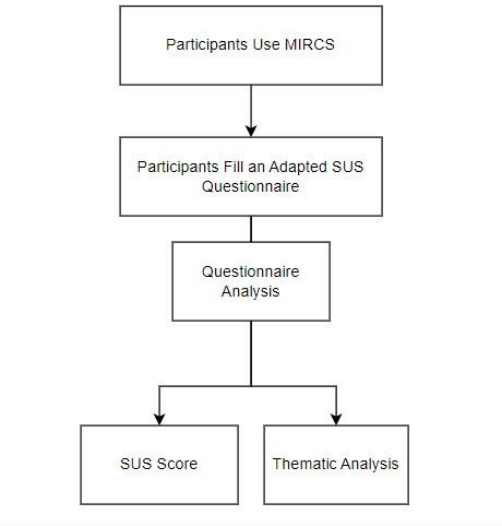

Figure 1: Research Flow Diagram for the study

Questionnaire Design

The first section of the survey was based on SUS, a commonly used 10-statement survey tool to evaluate system usability (Brooke, 1996). Ten (10) questions measuring the usability of the system are included: five positive questions and five negative questions (Appendix 1). Each question has a 5-point Likert scale with options ranging from strongly agree to strongly disagree, allowing respondents to indicate their level of agreement. Participants were asked for demographic and feedback data in the questionnaire's second section.

Profile of Respondents

Participants were students of Ibrahim Badamasi Babangida University, who use the MIRCS to get their semester results. The majority of respondents were Computer science students (86.1%) with 50.5% of the respondents in their final year of studies.

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RESULT

Descriptive statistics

Figures below show the results for the 10 SUS questions. Five positive questions in figure (2) and five negative questions in figure (3). All Questions were completed by all of the participants (101 total respondent) to confirm their involvement.

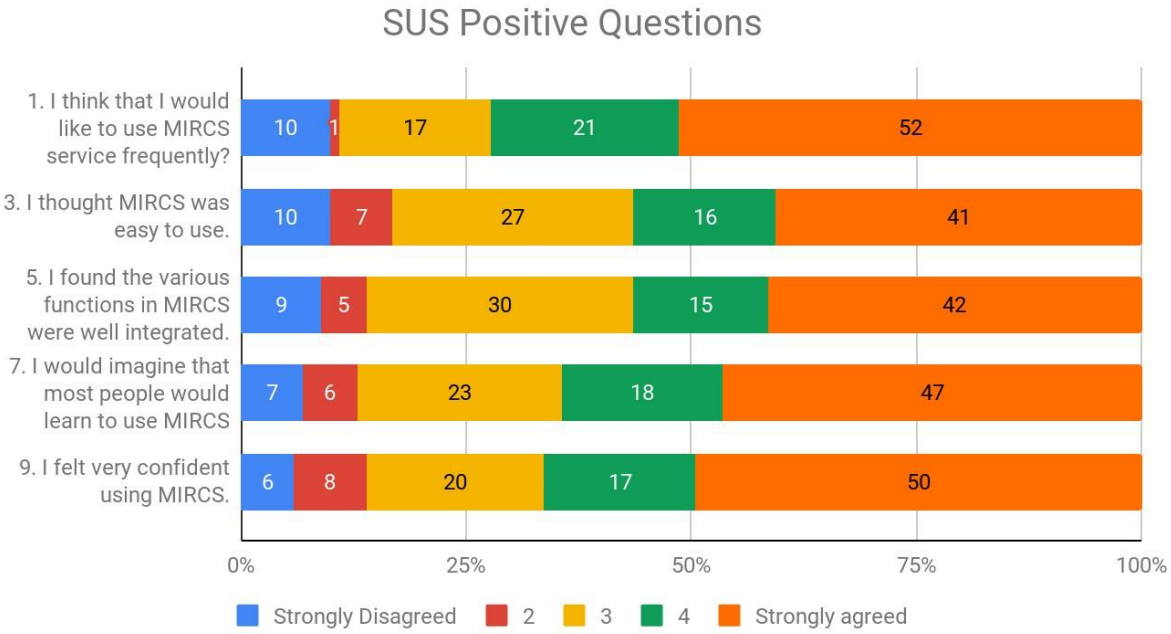

Fig. 2

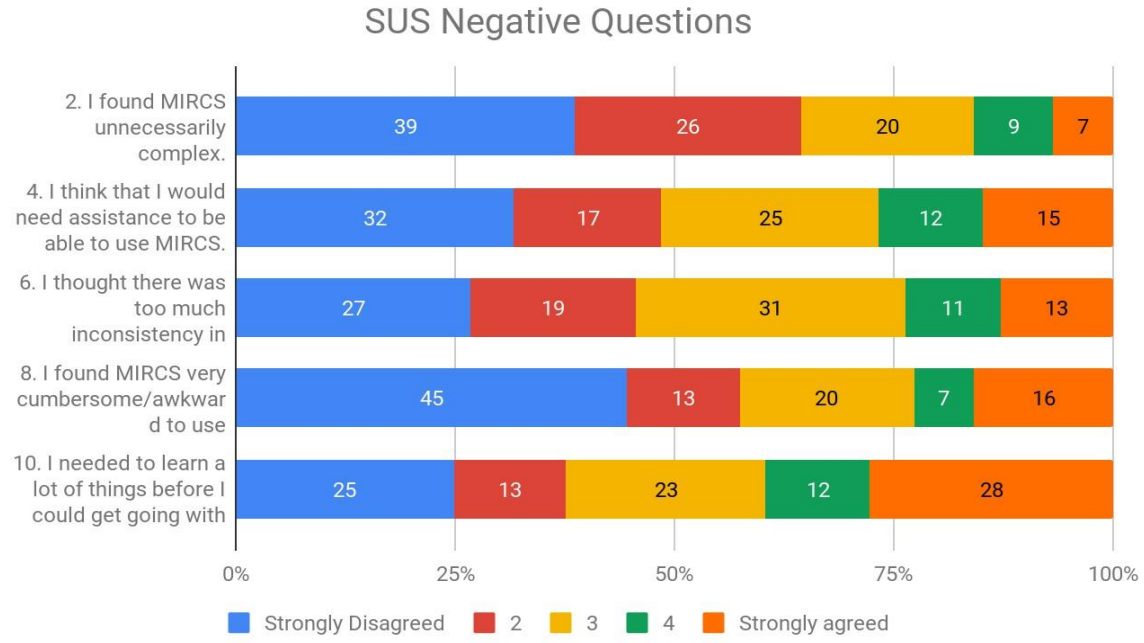

Fig. 3

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According to the first System Usability Scale (SUS) question (Q1), "I think that I would like to use this MIRCS frequently," there were 52 participants (51.5%) who strongly agreed, 21 participants (20.8%) agreed, 17 participants (16.8%) were neutral, 1 participant (1%) disagreed, and 10 participants (9.9%) strongly disagreed. This demonstrates that 73 respondents (72.3%), agreed they would like to use MIRCS frequently.

Regarding the second question's (Q2) statement that "I found the MIRCS unnecessarily complex," 39 respondents (38.6%) strongly disagreed, 26 disagreed (25.7%), 20 were neutral (19.8%), 9 agreed (8.9%), and 7 strongly agreed (6.9%). This demonstrates that 65 (64.3%) respondents did not think MIRCS was overly complicated.

In response to the third question's (Q3) statement, "I thought the MIRCS was easy to use," 10 respondents (9.9%) strongly disagreed, 7 disagreed (6.9%), 27 participants (26.7%) were neutral, 16 agreed (15.8%), and 41 strongly agreed (40.6%). Overall, 56.4% of participants found the MIRCS to be simple to use.

The fourth question (Q4), which asks, "I think that I would need the support of a technical person to be able to use this MIRCS" received the following responses: 32 participants strongly disagreed (31.7%), 17 participants disagreed (16.8%), 25 were neural (24.8%), 12 agreed (11.9%), and 15 strongly agreed (14.9%). This demonstrates that only 48.5% of the participants believed they could use the MIRCS without any assistance.

In response to the fifth question (Q5), "I found the various functions in this MIRCS were well integrated", 42 participants (41.6%) strongly agreed, 15 participants (14.9%) agreed, 30 participants (29.7%) were neutral, and 9 participants (8.9%) strongly disagreed. This demonstrates that only 57 participants (56.7%) thought the MIRCS various functions were effectively integrated.

According to the sixth question (Q6), "I thought there was too much inconsistency in this MIRCS", 27 respondents (26.7%) strongly disagreed, 19 respondents (18.8%) disagreed, 31 respondents (30.7%) were neutral, 11 respondents (10.9%) agreed, and 13 respondents (12.9%) strongly agreed. This demonstrates that only 24 respondents (23.8%) thought this MIRCS had too much inconsistency.

For the seventh question (Q7) which states that “I would imagine that most people would learn to use this MIRCS very quickly”, 7 respondents (6.9%) strongly disagreed, 6 respondents (5.9%) disagreed, 23 respondents (22.8%) were neural, 18 respondents (17.8%) agreed and 47 respondents (46.5%) strongly agreed. Therefore, the result shows that 65 respondents (64.3%) felt that MIRCS will be quick to learn.

Eighth question (Q8): "I found the MIRCS very cumbersome to use." According to the survey, 45 participants (44.6%) strongly disagreed, 13 participants (12.9%) disagree, 20 participants (19.8%) were neutral, 7 participants (6.9%) agreed, and 16 participants (15.8%) strongly agreed. This shows that more than half of the participants (57.5%) disagree that they found the MIRCS awkward to use.

The ninth question (Q9) which states that “I felt very confident using the MIRCS”, 6 respondents (5.9%) strongly disagreed, 8 respondents (7.9%) disagreed, 20 respondents (19.8%) were neural, 17 respondents (16.8%) agreed and 50 respondents (49.5%) strongly agreed. As a result, 67 respondents (66.3%) said they felt comfortable using the MIRCS.

Finally, in response to question 10 (Q10), which stated, "I needed to learn a lot of things before I could get started with this MIRCS," 25 respondents (24.8%) strongly disagreed, 13 respondents (12.9%) disagreed, 23 respondents (22.8%) were neural, 12 respondents (11.9%) agreed, and 28 respondents (27.7%) strongly agreed. Less than half of the respondents (39.6%) agreed that they would need to gain a lot of knowledge before using MIRCS.

Usability Score of SUS

The participants answer the SUS questions on a scale of 1 (Strongly disagree) to 5 (Strongly agree). However, the results of these responses are evaluated using Brooke's scoring system on a scale from 0 to 4. Since the SUS's scoring system requires responses to all 10 questions, a response that is left blank should receive a raw score of 3 (the middle point). SUS states that responses to questions that contain odd numbers are positive, while responses for even numbers are negative. Each item's score contribution ranges from 0 to 4. For the positively worded items 1, 3, 5, 7, and 9, the score contribution is equal to the scale position minus 1. Negatively worded items 2, 4, 6, 8, and 10 each contribute 5 minus the scale position (Brooke, 2013). For instance, if the user answers question 7 with a score of 5 (positive meaning), the outcome score will be 4, and if they respond for question 10 with a score of 3,

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the outcome score will be 2. The standard SUS score, which ranges from 0 to 100, is calculated by adding the adjusted scores together and multiplying them by 2.5.

In our survey, we have 101 respondents in 2019 and for each of the respondents, their SUS score and the adjusted rating scale were calculated. Because SUS results are expressed as scores between 0 and 100 rather than percentages, some people occasionally find the findings confusing. To aid in the interpretation and comprehension of the results, Sauro and Lewis (2016) provide an adjective grading scale for the SUS score in the table below

Table 1. Curved Grading Scale for SUS

Grade	SUS	Percentile Range
A+	84.1 – 100	96 – 100
A	80.8 – 84.0	90 – 95
A-	78.9 – 80.7	85 – 89
B+	77.2 – 78.8	80 – 84
B	74.1 – 77.1	70 – 79
B-	72.6 – 74.0	65 – 69
C+	71.1 – 72.5	60 – 64
C	65.0 – 71.0	41 – 59
C-	62.7 – 64.9	35 – 40
D	51.7 – 62.6	15 – 34
F	0 – 51.6	0 – 14

From our survey, below analysis show the SUS score for the questionnaire:
Total adjusted Odd numbered questions (X1) = 1450
Total adjusted Even numbered questions (X2) = 1225
Total of adjusted Odd and even numbered questions (T1) = X1 + X2 = 1450 + 1225 = 2675
SUS Score = 2.5 x (T1) = 2.5 x 2675 = 6687.50
Average SUS Score = SUS Score / Total number of participants = 6687.50 / 101 = 66.21. This study's usability score is 66.21, which equals a grade of C.

Thematic Analysis
Thematic analysis (TA) is a process for identifying, evaluating, and recognizing significant patterns (themes) in qualitative data (Clarke et. al, 2015). Braun & Clarke (2012) argue the phases of thematic analysis allow for a systematic way of seeing and the use of "coding" to process qualitative data. The below listed phases helped in organising relevant code arrangements and provided visualizations of critical elements.

1. Familiarity with Data: Engage yourself by reading and rereading the data. These data can be surveys, audio recording, videos etc. Making notes, writing comments and highlighting the potential items.
2. Generating Initial Codes: Potential features of data that are relevant to the research questions are identified. Codes as building blocks of analysis can describe and provide a concise summary of some data that are related to participants' meaning.
3. Searching for Themes: Finding areas where the coded data overlap and are relevant to each other by exploring relationships between themes and capturing relevant data to the research question.
4. Reviewing Potential Themes: Checking the quality of collated extracts of data and reviewing in relation to the entire dataset.
5. Defining and Naming Themes: Shaping the analysis with a clear focus, scope and purpose which builds on previous themes and selecting extracts to analyze and set out the story of each theme by clearly stating and defining your theme.
6. Producing The Report: The analysis final phase is to produce a scholarly report (Journal article or Dissertation). The goal is to provide a compelling and clear story of your analysis.

The analytical process for this study was inspired by and modified from Abuhlfaia & Quiecey (2019). At the end of the survey, participants had the opportunity to voice any thoughts they had about the MIRCS (second section of the questionnaire). Each participant's response was manually thematically analyzed using the coding template.

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1. *Accuracy: The accuracy of the MIRCS was measured by the participants' responses. 78 out of 101 respondents said that the result they received from MIRCS and the one which their department later placed on the wall was the same. For example, Participant 9 (P9) said "It's satisfactory", P25 said "I'm cool with the result", P29 said "Both the same", P63 said "No difference", P99 said "No discrepancy or difference". The remaining participants said their grade (CGPA) was slightly different. For example, P22 said "Yes", P30 said "I did not get what I expected in my result", P57 said "there was a little difference", P66 said "the CGPA are different".*
2. *Cost of Service (system charges): As sending results via SMS service is not free and it is even more expensive with USSD, it was asked of the participants how much they would be willing to pay for this personalized service in the future in order to evaluate the cost of the service. 76 out of 101 of the participants selected "Less than N50". For example, P28 selected "Less than N50", P81 selected "Less than N50". To this number, nineteen (19) of the participants said "Up to N100". Example, P39 said "Up to N100", P97 said "Up to N100". Two (2) of the participants said "More than N200 but not up to N500" while 4 of the remaining participants said "Willing to pay even more than N500".*
3. *Suggestion toward improving the service: The participants called attention to some features that might facilitate their access to the system (MIRCS). For example, P5 suggested "I think it needs improvement toward other networks, like the Glo users find it hard to check their results because of law network responsiveness". P7 suggested that "It should be implemented by other faculties". P9 suggested that "There Should Be Room for The Use of Phone Numbers Other Than That Shown in the school record for results checking". P16 stated that "The system should allow students to print out their results". P32 stated that "with the functionality of this system, I hope it faster to other higher institutions and not only ibbul". P38 suggested that "Make it more user friendly". P63 suggested that "More improvement is needed at results or CGPA calculations". P71 stated that "Yes getting through to the service was poor so there is need for a lot of improvements".*

In summary, many of the participants suggested that for affordability, the cost of the service should be less than N50. For the accuracy of MIRCS, most of the participants stated that their results were accurate in comparison to the one placed on the wall in their various departments while some stated that their IT results were not added to compute the Cumulative GPA. They also suggested that this MIRCS is worth implementing in other facilities and also, they can register other network providers apart from the one the school management is using to ease the access of the result if a particular network provider fails.

DISCUSSIONS

This study's primary goals are to evaluate the Mobile Interactive Result Checking System's (MIRCS) usability and to pinpoint some issues that students run into when using the system to access their results. The usability questions received an average SUS overall score of 66.23 out of 100. Majority of the students' responses on the accuracy of their results was that the result was the same as the one placed on the department wall while few of the students mentioned that either their CGPA is not corresponding or it shows they have outstanding courses, however stated that their Industrial Training (IT) grades were not added to the previous GPA which led to the incorrect Cumulative GPA. Some of the participants suggested the system to enable the reply of the student which in return will increase the accuracy of the system. They also mention that other mobile numbers should be registered in the system apart from the primary one the user is using to have a better chance when a network provider for the primary mobile number breaks down. Unfortunately, the system has not yet implemented some of these suggestions from the participants, its concerning and that is worth implementing.

CONCLUSION

This study uses the Software Usability Score (SUS) to evaluate the usability of a result checking system (MIRCS). Compared to Herawati et. al (2021) evaluation of higher education learning management system which yield a positive SUS score result (83.25), the SUS overall Score calculated in this study has Grade of C (66.23). Thus, it has been confirmed that while MIRCS has above average usability, it falls below the criterion set by SUS for applications. The thematic analysis of further data from participants highlights suggested areas for improvement of MIRCS such as cost of service, availability and reliability. Further work is therefore needed to implement these suggestions and evaluate the system usability and improvement in terms of cost effectiveness.

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ACKNOWLEDGMENT

The authors would like to acknowledge the financial support of the Tertiary Education Trust Fund (TetFund), Nigeria for this research under the Institutional Based Research (IBR) grant.

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p-ISSN : 2541-044X

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Appendix 1: Questions from the Software Usability Questionnaire used for the Study

1. I think that I would like to use this MIRCS frequently
2. I found the MIRCS unnecessarily complex
3. I thought the MIRCS was easy to use
4. I think that I would need the support of a technical person to be able to use this MIRCS
5. I found the various functions in this MIRCS were well integrated
6. I thought there was too much inconsistency in this MIRCS
7. I would imagine that most people would learn to use this MIRCS very quickly
8. I found the MIRCS very cumbersome to use
9. I felt very confident using the MIRCS
10. I needed to learn a lot of things before I could get going with this MIRCS

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