USABILITY EVALUATION OF NAVIGATION APPLICATIONS – GOOGLE MAPS AND WAZE

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ABSTRACT

A navigation application is a platform that provides users with directions to a destination via the shortest route. The usability of an application is an important factor in providing a good user experience. Hence, this study aims to evaluate the usability of the two popular and widely used navigation applications, Google Maps and Waze. Questionnaire-based evaluation method was used to test the effectiveness, efficiency, consistency and ease of use between both applications. The System Usability Scale (SUS) questionnaire was distributed to 40 users to help with the analysis. The findings showed that both applications provide real-time navigation services, but differ in their routing, data collection, and user experience approach. The operation and routing of Google Maps are more consistent, but with a complex interface. Waze offers better real-time rerouting based on user-submitted data. However, Waze's user-generated reports cause some inconsistencies, especially in less active areas. Through the SUS questionnaire that was distributed, Waze has a higher average SUS score (72.1875) while Google Maps has a lower SUS score (60.6875). Thus, Waze will have better usability than Google Maps. However, Google Maps has a faster average loading time (1.6795s) than Waze (2.60275s), which means that Google Maps can provide quicker access to navigation features. Google Maps also has a smaller app size (32.75MB) than Waze (69.20MB). Hence, Google Maps is better for users with limited device capacity. In conclusion, Waze has better overall usability while Google Maps will have better accessibility.

Keywords

Navigation applications, usability, Google Maps, Waze, System Usability Scale (SUS), user experience

1. Introduction

Navigation applications have become essential tools for millions of drivers nowadays [1]. Efficiency and accuracy in navigation are important to accommodate this fast world [1]. With the advancements in technology and the widespread availability of smartphones, these apps have become widely accessible to users across the users worldwide [1]. On the other hand, choosing the most efficient and user-friendly app can also highly impact users' travel experience. Thus, users tend to choose navigation applications that offer good-quality route planning with an interaction design so that it can assist them during their journey. The usability of these apps is important, as it affects user satisfaction, user experience, safety and overall convenience.

The ways navigation applications perform real-time traffic updates, route planning, collecting data, presenting information and assisting users during their journeys will be included as a part of the usability assessment. Usability is defined as the ability of a website to attract users under certain conditions and can be easily understood and used by the users [2]. To fit with the users, the navigation application should always update the latest information about traffic incidents or hazards to the users.

This study aims to evaluate the usability of Google Maps and Waze through a System Usability Scale (SUS) evaluation. Google Maps and Waze have been compared in terms of their ease of use, system integration, consistency, and user confidence [3]. The System Usability Scale (SUS) evaluation can be used to identify which app provides a better overall user experience. It also allows for a clearer understanding of how these navigation tools meet the needs of users in different driving environments. This user experience research is essential for both app developers and users to know about the strengths and weaknesses of each platform so that their product can bring to the fullest capacity [3].

The motivation for conducting this study is to gain greater reliability among users on digital navigation tools in their daily lives, especially in high-traffic urban areas where efficient route planning is critical. Thus, finding out which app provides a friendlier user experience and which one can deal more effectively with real-time traffic challenges will be quite important because millions of drivers rely on those apps every day to navigate through complicated road systems [1]. It is important for drivers to understand all these differences so that they can find a tool suited to their different driving needs and environments.

Google Maps and Waze are highly usable and available navigation apps [4]. However, based on our findings on 40 respondents, Waze has a greater average SUS score (72.1875) than Google Maps (60.6875), which means that Waze has a greater overall performance and usability. The finding can be further supported by the analysis of 10000 app reviews that we found online, 2.3% of Google Maps reviews said that the app was easy to use whereas 3.2% of

Waze reviews said the same [5]. If we compare both applications, Waze has a slightly higher overall score than Google Maps [5]. This is because the interface and design of Waze are more attractive and simpler than Google Maps [4]. Google Maps resembles an application with a more classic feel, complete with all the onscreen information, while Waze uses a simpler approach with fewer details and a cartoony design [4]. Waze only displays what you need to know like traffic and road hazards to provide users with a clearer interface while Google Maps will give users extra information that will mess up users' view [4]. The 40 respondents were also asked to fill in the loading time of Waze and Google Maps. Based on the results, Google Maps has a faster average loading time (1.6795s) than Waze (2.60275s). This means that Google Maps can provide users with immediate access to directions. Not only that, Google Maps also has a smaller app size (32.75MB) than Waze (69.20MB), which is suitable for limited device storage users.

2. Methodology

The evaluation of Google Maps and Waze was conducted using a System Usability Scale (SUS) questionnaire. The loading time of apps and the apps' size were also studied to find additional usability and comparisons with user experience. The combination of these methods is to ensure a more comprehensive understanding of each app's usability.

2.1 Questionnaire-based Evaluation Method

The primary method used in this study was the System Usability Scale (SUS). The ten-question survey provides a quick and reliable method for understanding the usability between two applications [6]. The experiment involved 40 users who were provided with Google Forms to evaluate both navigation applications. There were a few tasks that needed to be performed by all the users before filling out the Google Forms:

1. Make sure Google Maps and Waze are installed on their smartphones.
2. Choose a common location and search for it in both apps.
3. Use turn-by-turn navigation to drive to the selected destination.
4. Use the apps to view traffic conditions and how they report any hazards or delays.
5. Observe how the apps handle rerouting in case of traffic or obstacles.
6. Observe the user interface by observing the layout and design.
7. Take note of any advertising that appears in both apps.

After completing the tasks, the users need to fill out 20 questions of the SUS questionnaire. The SUS method evaluates key usability factors such as system complexity, ease of use, integration of features and user confidence. The users were asked to rate their satisfaction on both Google Maps and Waze on a 5-point Likert scale, from range 1 (Strongly Disagree) to 5 (Strongly Agree). Here is the 10 items questionnaire with 5 response options:

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

A total of 40 participants were involved in this experiment. The participants were chosen from casual users to those who frequently rely on these apps for navigation. This is to ensure that we can capture different users' needs easily. The data from the SUS questionnaire will be used to calculate individual scores for both apps. The overall SUS score for each app (Waze and Google Maps) was determined by calculating the average of all individual SUS scores. Then, the results will be compared to determine the application that has higher usability.

2.2 Data Analysis

The data from the SUS questionnaire was analyzed by calculating the SUS score for each participant. Then, we averaged the scores for both Google Maps and Waze users. This method allowed for a clear and reliable analysis of the usability between the two apps by comparing their overall usability. The individual SUS score was derived from:

1. Convert the Likert scale to numbers. For example, 1 for "Strongly disagree" and 5 for "Strongly agree" [7].
2. Subtract 1 from the response if it is an odd-numbered question [7].
3. Subtract the response from 5 if it is an even-numbered question [7].
4. Add the score of each question.
5. Multiply the total by 2.5 [7].

The interpretation of the SUS score after we get the result will be shown in Table 1.

Table 1: SUS score adjective rating and grade [8].

SUS Score	Grade	Adjective Rating
>80.3	A	Excellent
68 – 80.3	B	Good
68	C	Normal

51 – 68	D	Poor
<51	F	Very poor

2.3 Loading Time

The Google Forms were distributed to 40 users to get information about the loading time of both Google Maps and Waze on their phones. The users need to record the moment the app was opened until the map is fully loaded and ready for use (in seconds). Then, the average result of the loading time will be used to compare the performance between both apps.

2.4 App Size Comparison

The app sizes of the latest versions of Waze and Google Maps were recorded from Google Play. Both apps will be compared in terms of storage usage and download speed.

3. Results and Discussion

Based on the data collected from 40 users via Google Forms, we can better understand the age demographics and usage frequency of navigation app users. From Table 2, among 40 respondents, 32.5% of them were in the 35-44 age group. This was followed by 30% of respondents who were in the 25-34 age group and 27.5% in the 18-24 range. The users' age group of under 18 and 45 – 54 were found that less likely to use navigation apps. These results highlight that the majority of the users fall within young to middle-aged categories.

From the view of the usage frequency, we can summarize from Table 3 that 52.5% of participants were using navigation apps frequently while 22.5% of respondents used navigation apps at the rate of very often and sometimes. However, only a smaller portion of respondents which was 1% used navigation apps rarely. These results indicate that most of our respondents are very familiar with navigation apps and thus we can get an accurate result in our research.

Table 2: Age range of respondents

Age	Number of respondents
Under 18	2
18 – 24	11
25 – 34	12
35 - 44	13
45-54	2

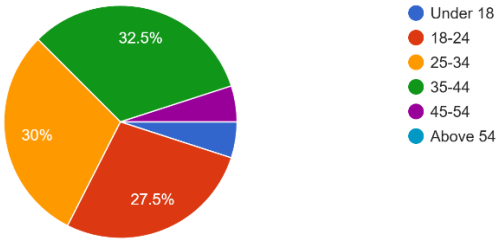

Figure 1: Pie chart of the age range of respondents

Table 3: Frequency of using navigation apps from respondents.

Frequency of using the apps	Number of people
Rarely (once a month or less)	1
Sometimes (a few times a month)	9
Frequently (a few times a week)	21
Very often (daily)	9

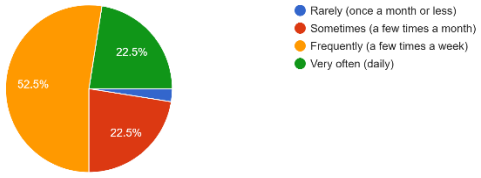

Figure 2: Pie chart of frequency of using navigation apps from respondents.

3.1 System Usability Scale (SUS)

In this section, we analyze each SUS question to understand the usability of Waze and Google Maps. Each question was rated on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The means and standard deviations from the respondents' answers can let us have a better understanding of the expression of users when they use these applications. So, we are going to analyze each question one by one.

Question 1: "I think that I would like to use this system frequently."

Based on Table 4, Waze scores higher in frequency of intended use, with a lower standard deviation indicating more consistent responses. This means that users have a stronger preference to use Waze frequently compared to Google Maps. This is because Waze has some extra features that Google Maps does not have. Waze users can report issues such as heavy traffic, cars stopped at the side of the road, speed traps, police sightings and traffic accidents so that the information can be directly

available to the users on the same route and other users can always be aware of [9]. This real-time information allows Waze to notify other drivers using audio. Not only that, Waze will also respond quickly to changing road conditions. Waze will bring users to the destination in the shortest time because Waze will redirect the road according to the users' traffic report. However, Google Maps also provides real-time traffic information but it relies on a mix of data sources. For example, historical traffic patterns, sensors and user data. Google Maps does not provide instantaneous rerouting, it only helps users plan around regular traffic patterns. Thus, the time needed for Google Maps users to arrive at their destination will be longer than Waze users if there is a traffic hazard.

Table 4: Summary table for Question 1 in the SUS method

No.	Waze	Google Maps
Mean	4.075	3.075
Standard deviation	1.022503213	1.163273454

Question 2: "I found the system unnecessarily complex."

Table 5 shows that Waze has a lower mean which is 2.175 than Google Maps, which is 3. This proves that most of the respondents disagree that Waze is unnecessarily complex. The lower standard deviation in Waze also marks that all responses are consistent. This is because Google Maps has included non-driving features such as public transportation, walking and cycling while Waze focuses thoroughly on navigation [4]. However, the extra feature given by Google Maps still makes functions for those who do not own their transportation.

Table 5: Summary table for Question 2 in the SUS method.

No.	Waze	Google Maps
Mean	2.175	3
Standard deviation	0.843907274	1.240347346

Question 3: "I thought the system was easy to use."

Table 6 shows that Waze Has a higher mean, 4.3 compared to Google Maps, 3.25. This indicates that most of the users agree that Waze is easier to use and navigate than Google Maps. The lower standard deviation in Waze also shows that the high consistent in responding. Thus, we can conclude that this is because the interface and design of Waze are more attractive and simpler than Google Maps [4]. Google Maps resembles an application with a more classic feel, complete with all the onscreen information, while Waze uses a simpler approach with fewer details and a cartoony design [4]. The comparison between the interfaces is shown in Figure 3 and Figure 4.

Table 6: Summary table for Question 3 in the SUS method.

No.	Waze	Google Maps
Mean	4.3	3.25
Standard deviation	0.790974731	1.149135684

Figure 3: Interface of Google Maps.

Figure 4: Interface of Waze.

Question 4: "I think that I would need the support of a technical person to be able to use this system."

This question is used to evaluate users' confidence in independently using the app. Based on Table 7, we can understand that both Waze and Google Maps users disagree that they need the support of a technical person to be able to use these apps because both applications get a low mean. However, Waze gets a slightly lower mean, which is 1.725 than Google Maps, 2.3. Waze gets lower mean shows that users feel confident using it without needing additional help. The lower standard deviation in Waze also shows that the responses in Waze are more consistent, which is 0.876692502. We can conclude that Waze's simplified navigation and focus on essential features have contributed to this ease of use, while Google Maps may feel slightly more complex in comparison.

Table 7: Summary table for Question 4 in the SUS method.

No.	Waze	Google Maps
Mean	1.725	2.3
Standard deviation	0.876692502	1.149135684

Question 5: "I found the various functions in this system were well integrated."

Based on Table 8, the mean score of Waze is 3.8 while Google Maps' mean score is 3.5 which is slightly lower than Waze. This shows that users generally feel that Waze's functions are more well integrated than Google Maps' functions. This is because Waze can provide a real-time feature on road hazards. Waze will inform users using audio about what should they be alert for while Google Maps only gives you an audio signal which then you will have to look at the screen to find out what that alert is [10]. Waze's higher standard deviation (0.939175853) shows that user opinions on feature integration vary. This could mean that some users find the feature integration very effective, while others may find certain aspects of Waze's interface less efficient.

Table 8: Summary table for Question 5 in the SUS method.

No.	Waze	Google Maps
Mean	3.8	3.5
Standard deviation	0.939175853	0.877058019

Question 6: "I thought there was too much inconsistency in this system."

Based on Table 9, shows that the mean of Waze (3.05) is higher than Google Maps (2.45). This means that most of the respondents found that Waze is more likely to be inconsistent than Google Maps. This is because Waze's entire operation depends on user-submitted data [4]. Waze will actively redirect you based on the data received and the functions will become worse when comes to rural areas. On the other hand, Google Maps will not automatically send users to a different path so it is more consistent and accurate [4]. The standard deviation in Google Maps is lower means that the responses are more consistent.

Table 9: Summary table for Question 6 in the SUS method.

No.	Waze	Google Maps
Mean	3.05	2.45
Standard deviation	1.239313292	1.13114419

Question 7: "I would imagine that most people would learn to use this system very quickly."

Based on Table 10, the mean of Waze (3.95) is slightly higher than Google Maps (3.275) proving that users are able to learn Waze faster than Google Maps. This is because Waze has a simpler interface and does not contain extra non-driving features. The standard deviation in Waze is lower means that the responses are more consistent.

Table 10: Summary table for Question 7 in the SUS method.

No.	Waze	Google Maps
Mean	3.95	3.275
Standard deviation	0.782828533	1.109111448

Question 8: "I found the system very cumbersome to use."

Based on Table 11, the mean of Google Maps (2.875) is slightly higher than Waze (2.05). This proves that most of the respondents state that Google Maps is more cumbersome to use. This is because Google Maps includes too many extra features. Both standard deviations are almost the same show that the consistency of responses is equal.

Table 11: Summary table for Question 8 in the SUS method.

No.	Waze	Google Maps
Mean	2.05	2.875
Standard deviation	1.036512892	1.066686699

Question 9: "I felt very confident using the system."

Based on Table 12, shows that the mean of Waze (3.625) is slightly lower than Google Maps (3.7). This shows that the users are less confident in using Waze rather than Google Maps. This is because the real-time feature in Waze relies on users to update the traffic information. Sometimes, this function in Waze becomes inefficient and unreliable when it comes to a rural area. Both standard deviations are almost the same show that the consistency of responses is equal.

Table 12: Summary table for Question 9 in the SUS method.

No.	Waze	Google Maps
Mean	3.625	3.7
Standard deviation	1.125178049	1.223697633

Question 10: "I needed to learn a lot of things before I could get going with this system."

Based on Table 13, the lower mean in both Waze (1.875) and Google Maps (1.9) shows that users disagree that they need to learn a lot of things before they can get going with these apps. Both applications are highly accessible and simple for users. Users can simply download the apps without the need to have extra knowledge. Waze's higher standard deviation (1.180775495) shows user opinions on the accessibility of Waze vary.

Table 13: Summary table for Question 10 in the SUS method.

No.	Waze	Google Maps
Mean	1.875	1.9
Standard deviation	1.180775495	0.955416408

This section will calculate the overall System Usability Scale (SUS) score for Waze and Google Maps. The System Usability Scale (SUS) scores provide an overall measure of user satisfaction and usability for both Google Maps and Waze[11], based on responses from a sample of 40 participants. According to the result shown in Table 14, the overall SUS score for Waze is 72.1875, which shows that Waze has a generally high level of user satisfaction and ease of use. However, the overall SUS score for Google Maps is 60.6875, which is lower than that of Google Maps, suggesting that users found it kind of complex to use.

Table 14: Overall SUS score for both applications.

Users	SUS Score for Waze	SUS Score for Google Maps
1	70	90
2	72.5	80
3	62.5	40
4	45	70
5	52.5	82.5
6	65	67.5
7	60	77.5
8	85	60
9	55	60
10	70	90
11	90	80
12	95	32.5
13	67.5	47.5
14	85	30
15	62.5	85
16	57.5	60
17	87.5	35
18	75	25
19	70	85

20	57.5	70
21	82.5	87.5
22	30	27.5
23	65	57.5
24	92.5	42.5
25	70	57.5
26	80	85
27	77.5	50
28	87.5	55
29	82.5	60
30	80	67.5
31	80	57.5
32	80	47.5
33	82.5	65
34	75	65
35	72.5	65
36	77.5	50
37	80	62.5
38	75	50
39	62.5	52.5
40	70	55
Average score	72.1875	60.6875
Standard deviation	1.240347346	17.8489702

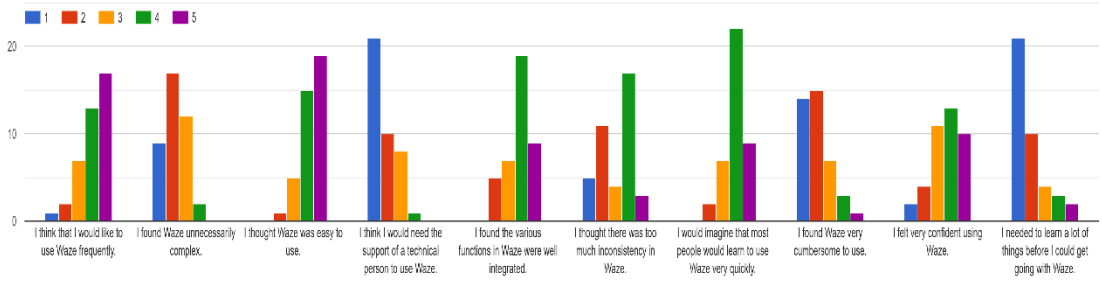

Figure 5: The bar chart summarizes the responses to each SUS question (Waze).

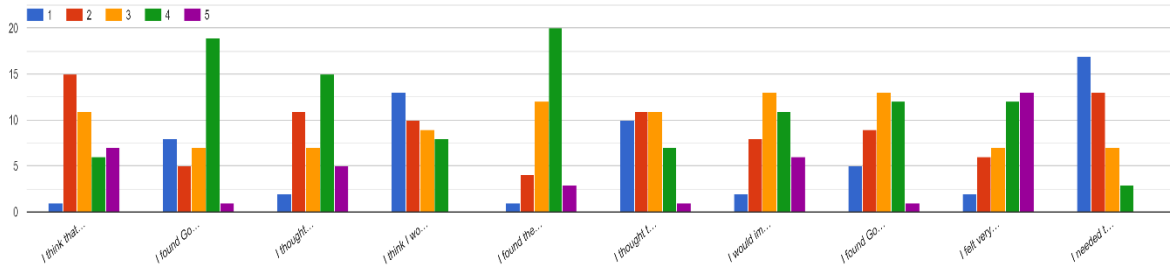

Figure 6: The bar chart summarizes the responses to each SUS question (Google Maps).

3.2 Loading Time

Application loading time is the amount of time taken by the application to completely initialize before the interface opens and the application becomes actionable or clickable for the user [12]. We distributed a Google Form to 40 users to get an average result on the Waze and Google Maps loading time. The results of the calculation are all presented in Table 15. Based on Table 15, Google Maps has the fastest mean load time which is 1.6795s, with a standard deviation of 1.6857375s. Waze has the slowest and longest load time, 2.60275s with a standard deviation of 0.3464823228s. The shorter the load time, the better the performance. In conclusion, Google Maps score the best performance. The standard deviation for loading times was slightly higher for Google Maps (1.6857375 seconds) compared to Waze (0.3464823228 seconds). This shows that Google Maps' load time is slightly more

variable. This variability may occur because of factors such as network speed.

Table 15: Summary of loading time

	Loading time of Waze (seconds)	Loading of Google Maps (seconds)
Mean	2.60275	1.6795
Standard deviation	0.3464823228	1.6857375

3.3 Application Size

App size refers to the amount of space an application takes up on a device's storage and is typically measured in megabytes [13]. This size can vary greatly depending on the app's complexity, features, and the type of content it contains [13]. App size is an important consideration for developers as it can impact user experience [13]. Figure 7 and Figure 8 show the application size of both Waze and Google Maps that were found from Google Play. Waze has a larger size which is 69.20MB, while Google Maps has a smaller app size of 32.75MB. In conclusion, Google Maps allows for faster downloads and updates, especially in areas with slower internet connections. This can improve usability for users who have limited connectivity. On the other hand, Waze may result in longer download and update times. Users with limited internet speed find it less convenient to download or update frequently. Thus, Google Maps has higher usability for users with low Internet connection compared to Waze.

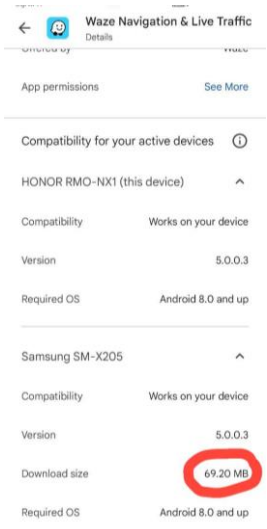

Figure 7: App size of Waze

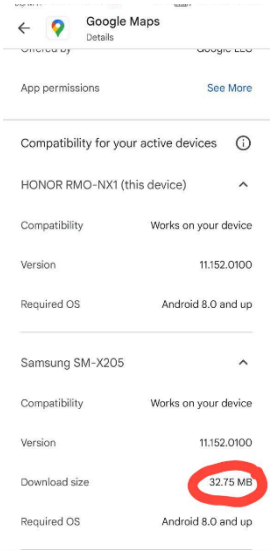

Figure 8: App size of Google Maps

4. Conclusion

In this usability study, we compare Waze and Google Maps across various metrics, including System Usability Scale (SUS) scores, loading time, and app size.

From the findings, Waze (72.1875) received a higher SUS score than Google Maps (60.6875). This shows that Waze has higher user satisfaction in terms of overall usability. Users are particularly attracted to Waze's real-time traffic data and interactive navigation features. In the field of loading time, Google Maps has faster loaded times with an average of 1.6795s compared to Waze (2.60275s). Thus, Google Maps can provide quick access which is suitable for users who focus on immediate start-up and stable performance of the app. Google Maps is also smaller in overall app size (32.75MB) compared to Waze (69.20MB). Thus, it is more accessible for users with limited storage or data plans as it is less storage demand and faster downloads.

The analysis shows that Waze has a higher usability than Google Maps. However, choosing between Waze and Google Maps will largely depend on individual preferences. Waze is suitable for users who like interactive interface, real-time features and a high overall usability experience, while Google Maps is suited for people who need quick access, storage efficiency and consistent navigation.

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