



Usability Evaluation of a Web-Based Portal (Mysikap) Using ISO 9241-11 Model

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Abstract

There is growing effort to evaluate the usability of web-based systems and mobile-based systems. With the increase in the development of web-based, applications coupled with the limitations and associated challenges, it becomes imperative to evaluate the web-based systems in the context of usability. Furthermore, a number of international standards/models on usability are available, but rarely use for practical usability evaluation. In this study, a survey was conducted on an online web-based system of Malaysian Road Transport Department MySIKAP. It is a new system for accomplishing road transport related transaction via online. The popular ISO 9241-11 standard was used to evaluate MySIKAP portal, a survey of five hundred (500) participants was conducted to measure users' perspective. The results revealed some pointers to usability issues as well as confirmation that the web-based transaction portal is relatively usable within the components defined in the models. Findings show that, contents, organization and readability contribute more to the usability of MySIKAP, while the user design interface of the portal is not. Although the navigation and links; effectiveness and efficiency are usable to the users, however the level of usability calls for greater improvement to provide users with better experience for an improved usability.

Keywords: Usability, web-based, MySIKAP, ISO 9241-11, Model

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Introduction

As the popularity of web technology is on the rise, it is no surprise that website design represents an issue of considerable importance to organizations. (Subramaniam *et al.*, 2000) shows that there is growing number of businesses taking over the web as an alternative means for marketing, brand reputation, advertisement, transactions and many other purposes. Therefore, customers' experiences are issues of significant importance within the cyberspace. Managerial attention is focussing on the opportunities provided by the Web to offer unique and satisfying customer experience

because a critical challenge facing businesses today, is to develop a Web presence that is not only compelling for the visitor, but is also able to serve his or her instrumental goals well (Azham *et al.*, 2015).

Many, especially the software quality professionals would have heard about the United State government's healthcare site (HealthCare.gov) where many have complained about its Website failures and its overall quality such as in (Ford and Perera, 2013). There might be many lessons that we can learn from these kinds of failures even though it is costly to learn from such mistakes all the time. Nevertheless, the popularity of

web-based application is well known that it becomes part of our daily life, ranging from simple to sophisticated; they generate millions in revenue as discussed in (Craig, 2018). It is a challenging task to develop; test and in some cases evaluate the quality assurance and usability of these sites (Redouane, 2002).

Whichever model is adopted in software development, usability evaluation becomes a very important issue (Speicher, 2015). Online users of websites/portals have many choices in finding information on websites. If users cannot find information and/or do so with difficulty, they certainly go elsewhere for an alternative source. They might also inform others about their frustrating experience and this will affect loyalty to the web-based product (Sauro, 2015). This underscores the importance of usability within the context of websites. The International Standard Organization (ISO) standard defines usability as the combination and convergence of effectiveness, efficiency and satisfaction (ISO_9241-11, 1998).

Usability can be measured within the above stated definition. Usability is both a performance as well as a perception, that is, it has to do with users having the ability to easily use the system and then express how they felt about the system they used. Effectiveness relates to whether users can actually complete their tasks and achieve their goals by using a given system while Efficiency refers to the extent to which users expend their resources in accomplishing their goals of using a system/product and Satisfaction is the degree of comfort and delight that users experience while achieving their goals or as they use the software. (Azham *et al.*, 2015). To sum it all, effectiveness and efficiency are performance dimensions of usability while satisfaction is the perception dimension of usability as demonstrated in (Azham *et al.*, 2015).

In this study, a usability evaluation was carried out within the context of a web-based system called MySIKAP. It is an online system of Malaysian Road Transport Department also known locally as Jabatan Pengangkutan Jalan (JPJ) Malaysia. The

system handles transaction via online, such as; driving license renewal, checking summons, road tax renewal and so on. The framework of the ISO 9142-11 model will be used for the standard measurement. ISO 9241-11 is a standard from International Standard Organization (ISO), which defines usability as the degree to which a product can be used by certain customers in given context in order to achieve their objectives in an effective, efficient and satisfactory in a specified context of use (ISO, 1998).

One of the reasons for adopting ISO 9241-11 model is its being a standard from the International Organization for Standardization (ISO) produced by international groups of experts after a rigorous review process, and represent a consensus on the current state-of-the art. The numbers of experts involved provide a more balanced perspective than is typically found in a framework from an individual or group of researchers. Other ISO 9241-11 versions such as ISO 9241-220 and ISO/IEC 25066 provide rich resources for usability practitioners and researchers, who may find the measures in ISO/IEC 25022 and 25023 useful. However, some standards focus towards certain goal like the ISO/IEC 25023, which is primarily intended for use in a software development environment, usability, is likely to be ignored in favour of the hard software qualities. Similarly, other frameworks for usability evaluation as discussed below are either tailored to a category of website or at the realm of proposal and undergoing evaluation.

The ISO 9241-11 revised version has been extended to include current approaches to usability and user experience and elaborated in the revised version of the model (Kurosu, 2016)

Goals: usability has been associated with achieving predetermined practical goals, but the concept has been widened in the new version of ISO 9241-11 to include achieving personal outcomes such as entertainment or personal development

Effectiveness: is completing a task completely and accurately without negative

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consequences such as economic harm, harm to health and harm to environment.

Efficiency: Is the time taken to complete a task, time efficiency or cost-effectiveness, having unnecessary actions or fatigue in carrying out a task

Satisfaction: Satisfaction has been redefined to take account of the wider range of concerns that are now recognised as important for user

experience: “positive attitudes, emotions and/or

Comfort resulting from use of a system, product or service”. These three aspects relate to the cognitive, affective and psychomotor responses of an individual

Wide applicability: The new draft makes it clear that usability applies to all aspects of use, including learnability, regular use, accessibility, maintainability.

ISO 9241- 11 Usability Framework

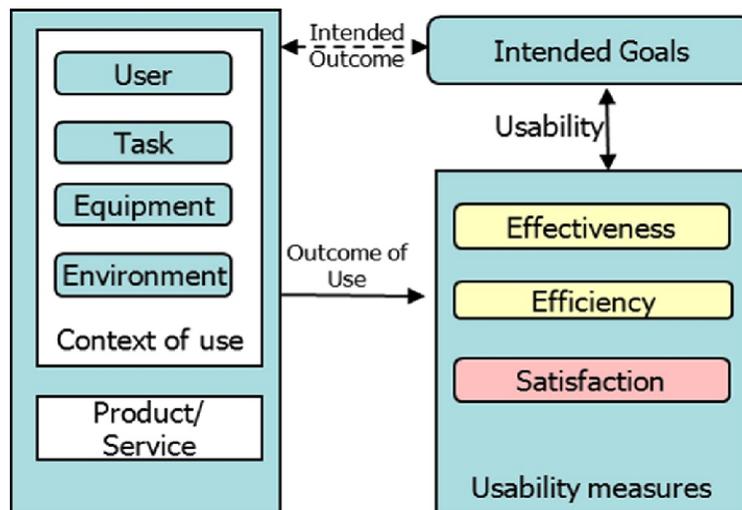


Figure 1: Usability (Evaluation) Framework of ISO 9241-11

The above figure shows quantitative usability design with metrics outlined for the user to have hands-on procedure. Effectiveness is measured by task performance; how far the user achieves desired goals, efficiency is measured by time taken and energy applied by user in relation to accuracy and task completion, and satisfaction is measured by users' perception in relation to experience while performing the task, which could be positive or negative. In the context of this research, the dependent variable is usability and independent variable is MySIKAP. Content Organisation and reliability, Navigation and Link, User Interface and Design, Effectiveness, Efficiency and Satisfaction are sub characteristic of usability in this context.

The remaining part of this paper will address the following sub-sections: related works,

methods and tools, results, discussion and conclusion.

Literature Review

Varieties of alternative approaches to usability evaluation have been proposed in previous literatures. (Foley and VanDam, 1982) described usability with respect to user interface guidelines as a property of the syntactic and semantic analysis of a user interface. (Smith and Moiser, 1984) considered usability as a product attribute. Others such as (Nielsen, 1994) identified eight distinct approaches as heuristic evaluation, guideline reviews, pluralistic walkthroughs, consistency inspections, standards inspections, cognitive walkthroughs, formal usability inspections, and feature inspections. Many approaches from different researchers present dimensions along which websites could potentially be evaluated. (Eighmey and McCord, 1998) for instance examined

audience experience of websites on eighty (80) evaluative statements across five (5) websites spanning a range of industries and products. The result grouped nine factors namely; personal involvement, useful information, simplicity of organization, and desire for relationship (Eighmey and McCord, 1998).

In another work, five major categories of factors to be considered while designing website for business were identified: page loading, content, navigation efficiency, security, and a consumer/marketing focus (Gehrke, D. and E. Turban, 1999). Similarly, (Katerattanakul and Siau, 1999) proposed a framework, which comprised four information quality categories: intrinsic, contextual, representational, and accessibility information quality. Furthermore, (Agarwal and Venkatesh, 2002) proposed five categories/constituents: ease of use, content, promotion, made-for-the-medium, and emotion. Their proposal also has subcategories like, relevance, media use, depth/breadth, feedback, structure, community, challenge, plot, personality, etc (Agarwal and Venkatesh, 2002).

There are two recurrent considerations in all these approaches to usability evaluation. First, is the notion that usability is multifaceted and must be assessed by using a variety of different measures. Second is that common characteristic of usability evaluation methods is their dependence on subjective assessments in the form of user judgments. Thus, usability is not intrinsically objective in nature, but rather subjective.

In evaluating usability of a web-based, some researchers focused their assessment on devices such as computer while others focused on mobile technology. (Coursaris and Kim, 2011) stated that although a considerable volume of research on general usability exists, relatively, few studies have been done with focus on mobile technology. Their findings revealed only 41% of mobile usability research studies were empirically inclined (Coursaris and Kim, 2011). Their framework consists of three components: the first outer layer includes four factors, namely: user, technology, task/activity, and

environment. The second inner layer has the key usability dimensions that is, effectiveness, efficiency, satisfaction, learnability, flexibility, attitude, operation-ability, etc.

Studies have shown that usability frameworks are often developed to evaluate category of website. Sirius usability framework uses heuristic analysis of expert to evaluate different e-commerce websites (Torrente *et al.*, 2013). Another framework integrates heuristic, user testing and Google Analytics to evaluate the usability of e-commerce websites (Hasan *et al.*, 2013). Task User Representation and Function (TURF) is a framework proposed to analyse usability of Electronic Health System (Zhang and Walji, 2011). There are many other existing frameworks for evaluating e-learning system such as in (Zaharias, 2011) and (Chiou *et al.*, 2010). Recently, a proposed General Graphical and Structural Evaluation (GGSE) framework was developed to provide general-purpose framework for evaluating all categories of website, eight different website were evaluated with the framework and the result proved effective even though it has limitation of narrow scope (Nazir *et al.*, 2018)

Another study adopted ISO 9241-11 Model to evaluate the usability of web based Health awareness portal on a mobile device (Azham *et al.*, 2015). A Lab usability testing method was employed based on three performance metrics of the ISO 9241-11 model (task time, task completion rate and task error). The overall usability of the portal is high and usable to the users in performing their task. It was also revealed that, the said users of the portal find it very difficult to translate the contents of the portal to their own choice language therefore; the translation function of the portal should be readable and understandable to the users

Similar study also employed ISO 9241-11 model to evaluate the usability of mobile health Application in Pakistan. (Dahri *et al.*, 2020) The ISO 9241-11 performance metrics (task success rate, errors, efficiency and satisfaction) were applied to measure the usability of the application. Fifteen (15)

patients performed a given task on the application based on the said metrics. It was found that, more than 60 percent users finds the mobile application usable. The users could be registered easily at the very first time on the application whereas frustrating in finding an appropriate doctor for a given patient.

Related study also adopted ISO 9241-11 model and evaluated the usability of wadaya website based on the three usability factors namely efficiency, effectiveness and user satisfaction (Arthana *et al.*, 2019) The evaluation methodology is categorized on existing system, development of wireframe as an alternative and alternative design system. Ten (10) users participated in the evaluation process consisting of first time and expert users. The results reveals some usability issues of wadaya website particularly completing a given cultural object task. In addition, the alternative has been improved and found out to be usable to the users.

With regard to evaluation methods used for website usability assessments, it has been observed that heuristic evaluation and laboratory testing are two of the most frequently used approaches (Kantner and Rosenbaum, 1997). Heuristic evaluations are assessments conducted by a small group of evaluators against a pre-established set of guidelines or “heuristics” (Nielsen, 1994). The evaluators are generally experts in usability, although it is desirable to use individuals who are both usability and domain experts (Kantner. and Rosenbaum, 1997). In contrast, laboratory testing utilizes real users as subjects and provides detailed insight into specific problems and issues that users face while interacting with the target website. Recent studies suggest that different usability evaluation methods are being deployed in various areas such as in mobile health application (AbdulSamad *et al.*, 2019), mobile tracking application (Murtaja *et al.*, 2020) and in e-learning Management System (Mukhtar *et al.*, 2019).among others. A survey has proved that, lack of implementation of software quality assurance

activities has lead web based systems or applications in losing their usability (Mukhtar *et al.*, 2019).

It can be observed from above that there are specific frameworks for mobile and website usability evaluation. However, this study requires that the evaluation be done with the two contexts in view, therefore, a model more general is required. The ISO 9241-11 fits well in this effort to evaluate usability on MySIKAP web portal from users’ perspective.

Materials and Methods

A survey method was used to measure the usability of MySIKAP websites from users’ perspective on the application (Subjective user preferences). These measure users’ performance preferences to the system by asking them to elicit their opinions via questionnaire for rating the system. The technique ensures anonymity and provides freedom to the respondents with broader capability to target more population from different environments within a time frame. It avoids the Hawthorne effect associated with controlled environment/observations.

ISO 9241-part 11 deals with the extent to which a product can be used by specified users to achieve specified goals with effectiveness (Task completion by users), efficiency (Task in time) and satisfaction (responded by user in terms of experience) in a specified context of use (users, tasks, equipment & environments).

The remaining of this segment discussed Questionnaire, Sample size, Reliability and Validity as well as Usability (Evaluation) framework of ISO 9241-11.

Questionnaire and Survey Methods

There are various questionnaires used to evaluate websites usability, among such include SUMI (Software Usability Measurement Inventory), QUIS (Questionnaire for User Interface Satisfaction), NIST Web Metrics (The National Institute of Standard and Technology Web Metrics), and MUMMS (Measuring the Usability of Multi-Media) to access multi-media websites and WAMMI (Website Analysis and Measurement

Inventory) to access website (Marzanah *et al.*, 2013).

This study adopted the questionnaire of (Thiam and Siti, 2008) as evaluation method. The questionnaire was divided into two parts, the first part focus on the user information such as name, gender, category, internet experience and most use browser. The second part includes the twenty-four (24) questions that are used to evaluate the usability of the websites. The questions are divided into four, each consists of six questions:

Content, organization and readability: Questions for evaluation are;

- This website is up-to-date and contains relevant materials
- It was easy to learn to use this website
- I am comfortable and familiar with the language used.
- The contents of this website are well structured and organized.
- I can easily make payment through the website
- There is no need to scroll left and right when reading from the website

Navigation and links: Questions for evaluation are;

- The website provides useful links for me to achieve desired result.
- I can easily navigate around the pages of the website.
- It is easier to move forward and backward, upward and downward in a page
- I can easily perform road tax renewal
- It is easier to send queries
- The organization of information on the system screens was clear

User interface design: Questions for evaluation are;

- The interface of this website was pleasant
- I am comfortable with the colors used at this website
- This website has no irritating feature
- This website maintains consistent look and feel
- This website does not contain too many web advertisements
- The design of visual layout and buttons are attractive

Effectiveness, Efficiency and Satisfaction: Questions for evaluation are presented in the Table 1 below:

Table 1: Measures of Effectiveness, Efficiency and Satisfaction

Effectiveness	Sample Questions	Options
Tasks completed	Tasks are run to completion	Strongly agree
Objectives achieved	Accurately	Agree
Errors in a task		Disagree
Tasks with errors	Error(s) are encounter while performing a task?	Strongly disagree
Task error intensity		
Efficiency	Sample Questions	Options
Task time	There is delay in response time when performing a task	Strongly agree
Time efficiency		Agree
Cost-effectiveness		Disagree
Productive time ratio	It is cost-effective with task done seamlessly without fatigue	Strongly disagree
Unnecessary actions		
Fatigue		
Satisfaction	Sample Questions	Options
Overall satisfaction	Overall, I am satisfied with how easy it is to use this system	Strongly agree
Satisfaction with features		Agree
Discretionary usage		Disagree
Feature utilisation	There are no concerns over the system security and trust	Strongly disagree
Proportion of users complaining about a feature		
User trust, User pleasure		
Physical comfort		

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The questionnaire was distributed to six hundred (600) users of MySIKAP to measure the usability of the website, but only five hundred (500) users were retrieved from those who volunteer to participate in the survey. The targeted participants were mostly students who performed one transaction or the other via the online system. The authority handling the portal assisted in getting the participants, which cut across different Malaysian states with more than 50% from Kuala Lumpur. The tasks are broken down inform of questions in a questionnaire as depicted in table 1. Responses from users are aggregated and divided by total responses to get an average of usability core for each question.

Data Analysis

The System Usability Scale (SUS) with a 4-point Likert-type questionnaire with six (6) item questions and with options ranging from, strongly agree, agree, disagree to strongly disagree. SUS is reliable and valid; its scores have a modest correlation with task performance and it measures both learnability and usability (Brooke, 2013).

The steps for evaluating MySIKAP website are as follows: Each respondent answers the usability evaluation questionnaire for the website. Participants' responses were collected manually. Merits are assigned according to response for each question. The merits are then accumulated based on the four usability categories. Mean value for each category is considered as the usability point for that category. Overall website usability point is the mean value of usability points for

the website and the usability points determine usability level.

The results obtained were collected, summarized and analysed, R studio was utilized to plot the different bar chart depicting pictorial representation of the results. The dependent variable (number of responses) was plotted against the independent variable (distribution of responses) and the percentage scores were realized

Reliability and Validity

Reliability and validity are two elements use in the instrumental measurements evaluation such as questionnaire. The value of alpha measure the internal consistency of a test and it is defined as number ranging from 0-9 (Cronbach, 1951). (George and Mallery, 2003) provide the following rules of thumb: "> .9 – Excellent, > .8 – Good, > .7 – Acceptable, > .6 – Questionable, > .5 – Poor and < .5 – Unacceptable". (George and Mallery, 2003)

Cronbach's alpha, is the most widely used objective measure of reliability and it is used to measure the reliability of the questionnaire adopted for this study. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. Reliability test was conducted on the data that was obtained from the pilot study as showed in table 2 and table 3 for the final study.

The below Tables 2 and 3 shows the Cronbach's Alpha result of both pilot and actual study to be 0.789 and 0.823 respectively. This reveals that the instruments (questionnaire) used in this study has good reliability and appropriate for the study.

Table 2: Reliability Test of Pilot Study

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
0.798	0.798	24

Table 3: Reliability Test of Final Study

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
0.823	0.823	24

Results and Discussion

Content, Organization and Readability

The first part of the questionnaire requires the users to evaluate the overall website content and readability. From Figure 2 below, it shows that more than half of the users are satisfied with the contents of MySIKAP website thus the contents are organised, well arrange and can be read without any difficulties. Only 28 percent were not satisfied with the contents, organization and readability of the website,

thus the overall contents of the MySIKAP is usable.

Navigation and Links

Figure 3 below shows that more than 50 percent of MySIKAP website users find the Navigation and Links of the sites to be usable to them even though the level of usability is within mid-level percentage as 44% of the response are not comfortable with the navigation and links; therefore there is need for enhancement of the navigation and links to be more user friendly.

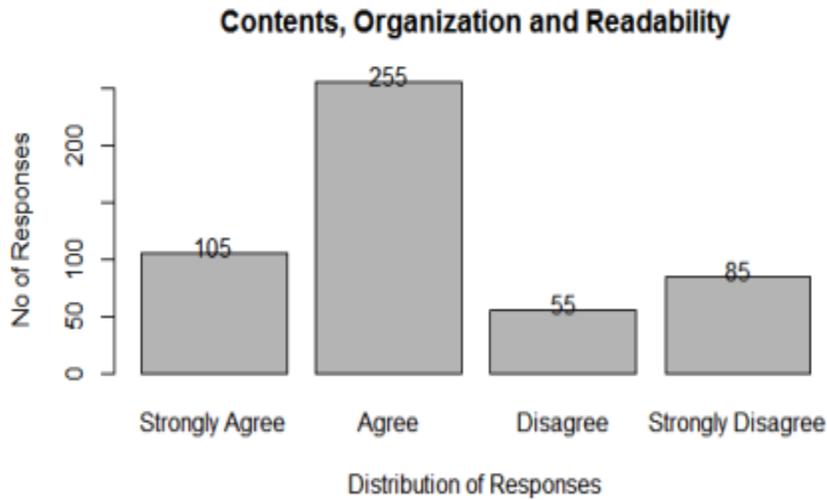


Figure 2: Percentage on Content, Organization and Readability

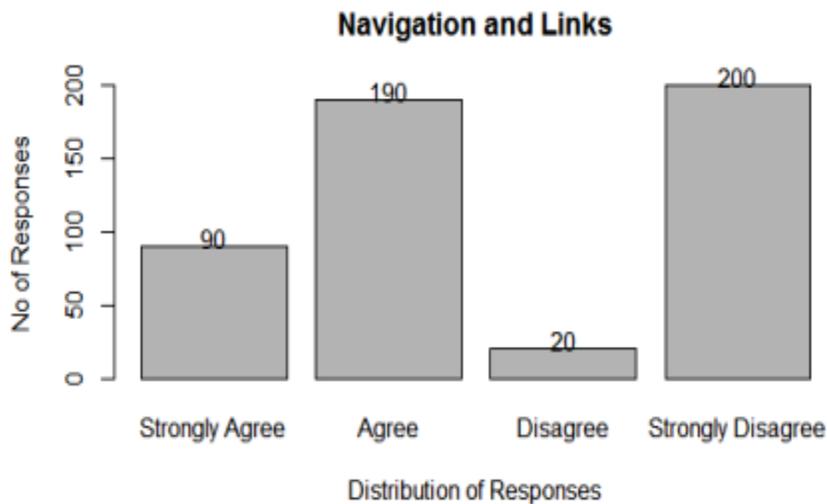


Figure 3: Percentage on Navigation and Links

User Interface Design

User interface is one of the essential part in satisfying the needs of the customers. From figure 4 below revealed that, majority of the users are not satisfied with the MySIKAP interface as such the interface is not pleasant to them and the design to a certain extent obsolete. The results show that there is need for more improvement in the User Interface design. 56% of the response indicated a poor design on the interface hence the usability of the website is diminished.

Effectiveness, Efficiency and Overall Satisfaction

MySIKAP effectiveness is of paramount important to the users especially when the users request a service from or make payment to the websites, producing desired result without error(s) indicate the effectiveness of

the application. However, too much time for the website to respond to users' request is a major problem that affects efficiency of the entire website. It can be seen from figure 5 below that 57.2% of users are comfortable with effectiveness of the application, the result further shows that a little more than half of the users of MySIKAP suffered in one occasion or the order responds time delay (efficiency), which takes long time than expected to meet the needs of the users depending on the device and bandwidth., again, satisfaction level is not encouraging, even though roughly half specifically 53% of the respondents are satisfied, but still need to improve MySIKAP to make it more effective and efficient for the overall satisfaction of users is inevitable.

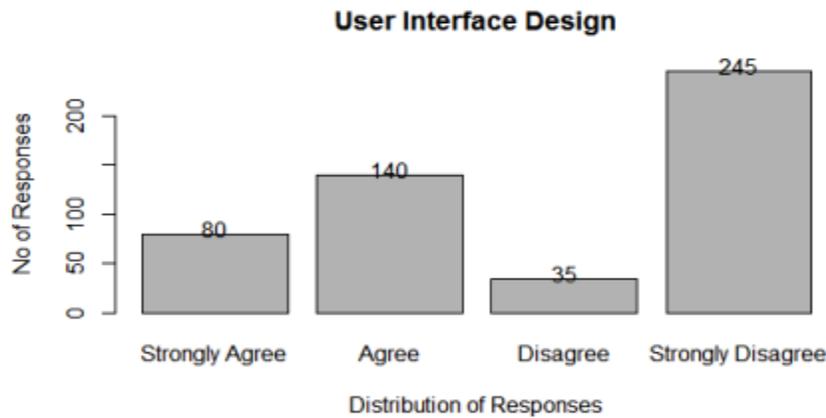


Figure 4: Percentage on User Interface and Design

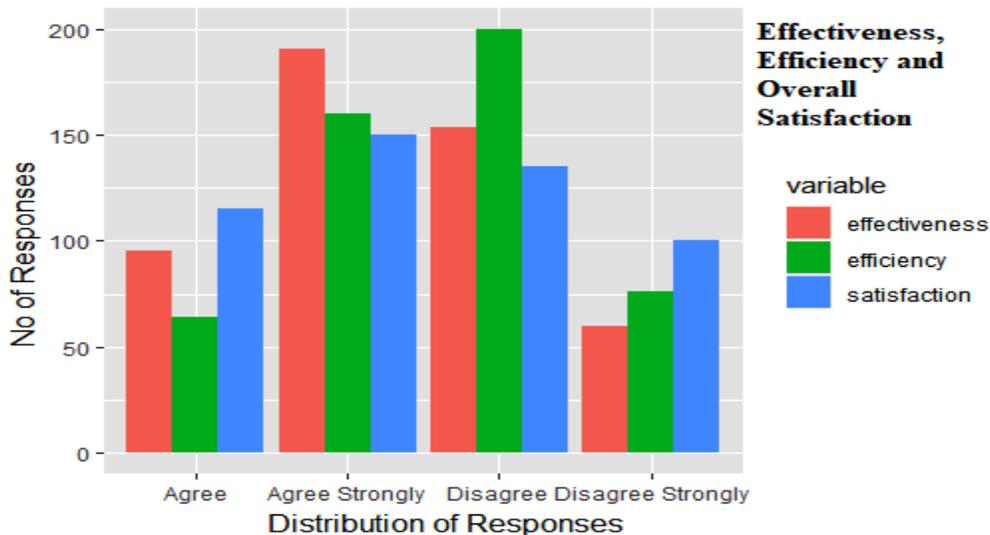


Figure 5: Percentage on Effectiveness, Efficiency and Satisfaction

Summary

From the usability analysis, there were some indicators of usability issues observed, it could be seen that the MySIKAP web-based portal, is relatively usable. In terms of contents, organization and readability, a considerable number of users found the contents readable, useful and relevant to their needs, in addition, the structure is well organized to their liking. With regard to navigation and links, usability was relatively achieved with minimal percentage as users were roughly divided on the ease of use of navigations and link, which again prompt more concerted effort for improvement. However, the user interface design of the portal is not usable to the end users as demonstrated in the result, therefore, there is need to improve the interface to make it more attractive and acceptable. In terms of effectiveness and efficiency, a considerable number of users were successful in accomplishing their goals with the webpage, however, there were varying level of disagreement from almost half of the users on response time (efficiency). However, since the perceived satisfaction score for the portal was relatively higher, it implies that users were satisfied with the usability of MySIKAP.

Conclusion

In conclusion, ISO 9241-11 standard was used to evaluate the usability of MySIKAP portal, a survey of five hundred (500) participants was conducted to measure users' perspective. The result shows that, contents, organization and readability contribute more to the usability of MySIKAP; however, the user design interface of the portal is not. Although the navigation and links; effectiveness and efficiency are relatively usable to the users, but with the level of usability they are at mid percentage thus prompting more improvement. Future works will examine the usability of MySIKAP portal on mobile devices and compare it with results produced from web-based computer system context of use.

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