

Evaluation of the usability of the Hamava system using heuristic evaluation

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ABSTRACT

Introduction: As university systems are dealing with a wide range of users, including students, managers, and university employees, these systems can likely satisfy the needs and activities of various users with maximum quality in the shortest possible time. Consequently, it is very essential to observe usability features in the design of such systems. The current study aimed to evaluate the usability of the Hamava system to recognize and resolve its problems and weaknesses.

Material and Methods: The present study is a cross-sectional descriptive study that was done in the second half of 2022 on the Hamava system of students of Birjand University of Medical Sciences. Nielsen's Heuristics (ten principles) were used to check the compliance of this system with the usability principles. Descriptive statistics were used to analyze the overall severity of the identified usability factors collected using the checklist.

Results: In the present evaluation, 176 problems were recognized, with the highest number of problems related to the violation of the two principles of aesthetic and minimalist design (n=58), user control and freedom (n=31), and the least problem related to the recognition rather than recall principle (n=4).

Conclusion: The results of the current study revealed that though a large number of users of the Hamava system are students and it is expected that this system will be designed based on the latest standards and the needs of its users, this system also faces usability problems that if not resolved, it can cause an increase in errors, dissatisfaction of users, decrease in the quality of information, waste of users' time, and lack of effective user interaction with the educational system.

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INTRODUCTION

Nowadays, the World Wide Web (WWW) is used as the key tool to access information. Due to this fact, it is essential for users to continually check and assess the usability of web resources [1]. The usability criterion of information systems in line with information technology is one of the basic elements of user interaction and improvement of information systems. Likewise, this criterion plays a main role in designing the user interface of the systems. Using usability principles, it will be determined how the user interface can be used easily [2].

One of the information systems is university websites, which, as well as being a suitable method in terms of cost and time to communicate with numerous users such as students, faculty members, and staff, similarly offer an image of the university and university services [3]. Ever since universities are a significant part of e-government, the e-government realization is not conceivable lacking an efficient website for universities [4]. The organization of the website must be logical and consistent with the users' expectations. Users should feel comfortable while browsing the website. Good

arrangement of information is very important in the usability of the website. Information must be classified logically and hierarchically and efforts should be made to prevent information from being hidden [5].

Usability is one of the capabilities of information systems, the use of which leads to the delivery of quality services and is attained by bearing in mind the needs of users and using standard methods in system design [6]. Usability was introduced by Asen in three independent variables including task characteristics, user characteristics, system characteristics, and the dependent variable of user reaction [7]. Determining the usefulness and efficiency of a web page to determine and meet the information needs of users in an improved, faster, and more effective way, as well as knowing the factors affecting its quality and usability, in other words, the ease and adaptation of the web page in its use to attain user goals are the usability principle. The usability of websites and software under it plays an important role in creating optimal communication between audiences, organizations, and employees of those organizations. Furthermore, to realize a suitable design of the systems, it is essential to assess the usability of that system [8].

There are numerous methods to assess and recover the user interface of information systems, one of which is heuristic evaluation. In heuristic evaluation, evaluators assess whether the system's user interface design follows a set of predetermined standard principles and recognize their violations as usability problems. Usability problems such as incorrect and ambiguous messages of the system, unfamiliar language and feedback lacking important information, etc., cause a reduction in efficiency, confusion of users, system inefficiency, unproductive interaction of users with the system, and a decrease in productivity and user satisfaction [9].

As university systems are dealing with a wide range of users, including students, managers, and university employees, these systems can likely satisfy the needs and activities of various users with maximum quality in the shortest possible time [10]. Consequently, it is very essential to observe usability features in the design of such systems [11]. Furthermore, the findings approved the increase in the number of universities and students at different levels [12]. So, with the upsurge in the number of users, the systems should pay attention to the types of their information needs, including information accessibility, ease of learning and user training of the system, ease of carrying out data retrieval processes, and shortening data retrieval procedures, etc. and reduce the amount of time and effort of the user to perform tasks [5].

Valid usability indicators comprise stability and uniformity in the design of systems with the same

performance, system adaptability to users' expectations, the ability to learn the system without spending a lot of time and energy, system flexibility in performing functions, minimum activity in performing tasks, minimum memory load, considering the perceptual limitation in designing the interface and the existence of suitable guides in different departments and the like [13].

In the Hamava system, many tasks are presently done for students, such as online tuition payment, choosing a course, registering applications for brilliant talents, academic profiles, registering grades, etc. To this end, this website should be able to simplify access to information for users. Otherwise, the provided content will remain unused or underutilized. Accordingly, factors such as the layout and design of pages, visual and graphic appeals, link management, and efficient search play a decisive role in facilitating access [14].

The results of the study by Ssemugabi et al. [15] aimed at evaluating e-learning applications indicated that heuristic evaluation using experts identifies more problems compared to the evaluation method by end users with 69 learners. Likewise, this study settled that heuristic evaluation is a suitable, efficient, and effective method for e-learning applications. In the study of Paz et al. [16], they used the heuristic method as a complement to the usability test to evaluate a transactional website (which provided the possibility of booking hotels in different cities and countries around the world). Five user interface experts conducted transactional websites and a total of fifty-nine problems were identified. Then, the usability test was done with the participation of eight master's degree students in informatics engineering. The results reveal that many of the problems identified using usability testing were formerly identified by the heuristic evaluation.

Due to its simplicity, low cost, and speed in identifying problems, heuristic evaluation is still one of the common methods for evaluating information systems [17, 18]. As far as our investigations have revealed, so far, no study has been conducted regarding usability evaluation using the heuristic method on the Hamava system, and on the other hand, incessant evaluation of information systems including the Hamava system averts possible errors and via identifying the problems in the system, the possibility of programming to eliminate them and finally provide better services is provided. Consequently, the researchers tried research to evaluate the usability of the Hamava system to recognize and solve the problems of this system.

MATERIAL AND METHODS

Study design and setting

The present study was a descriptive cross-sectional conducted in 2022 in Iran. Hamava system (Sama) is the main online service portal in Iran's universities governmental and nongovernmental. All the processes of registration, unit selection, payment, transfer, receiving semester report cards, etc. are done through this system. This software is currently used in most of Iran's universities to carry out the necessary measures to carry out the educational affairs of students at different levels. In this study, the heuristic evaluation method was used to determine the usability problems of the "Hamava" system user interface. It is worth mentioning that considering that the heuristic evaluation examines the degree of compliance with the predetermined standard principles in the design of the user interface of the

information system. As a result, the findings of this research are not specific to a university. This study was carried out at Ferdows School of Health and Allied Medical Sciences affiliated with Birjand University of Medical Sciences.

Study participants and sampling

Five experts participated in the evaluation of the "Hamava" system. The three evaluators were Ph.D. in Health Information Management who were familiar with different information systems and various methods of evaluating information systems and the other evaluators were students in Health Information Technology and had more than 4 years of experience working with the "Hamava" system (Table 1).

Table 1: General characteristics of the evaluators attended in the usability evaluation (n=5)

Evaluators	Number	Experience years	Age range	Field of study	Degree	Gender
Supervisor 1	2	10	30-40	Health Information Management	PhD	Female
Supervisor 2	1	10	30-40	Health Information Management	PhD Student	Female
Students	1	2	20-30	Health Information Technology	BSc Student	Female
Students	1	4	20-30	Health Information Technology	MSc Student	Male

Data collection tool and technique

In this study, the heuristic evaluation method was used which includes ten indicators as follows:

- 1-Visibility of system status, 2-Match between system and the real world, 3-User control and freedom, 4-Consistency and standards, 5-Error prevention, 6-Recognition rather than recall, 7-Flexibility and efficiency of use, 8-Aesthetic and minimalist design, 9-Help users recognize, diagnose, and recover from errors, 10-Help and documentation [19].

The present study was conducted in four steps. In the first stage, five evaluators independently examined the Hamava system in terms of compliance with Nielsen's principles of applicability and entered the problems found in Excel. In the second stage, five lists completed by the evaluators were reviewed. Problems that were common to the lists were removed, and a single list of all problems was created. Any disagreement between the evaluators was resolved through discussion and negotiation.

In the third stage, descriptive statistics were used to analyze the overall severity of the identified usability factors. The mean and standard deviation of the overall severity score were calculated for each heuristic principle. The severity of the problems was determined based on three criteria: frequency of

exposure to risk, impact of the problem on the user experience, and persistence of the problem. Each problem has a severity range (0 = no problem, 1 = cosmetic, 2 = minor 3 = major, and 4 = catastrophe); the average severity of each problem was obtained by dividing the sum of the severity by the number of evaluators who identified the problems. Finally, the average severity of the problems was calculated and reported based on Table 2 [20].

Table 2: Nielsen's severity rating scale for usability problems

Problem	Severity	Description
No problem	0	I don't agree that this is a usability problem at all
Cosmetic	1	Need not be fixed unless extra time is available on the project
Minor	2	Fixing this should be given low priority
Major	3	Important to fix so should be given high priority
Catastrophe	4	Imperative to fix this before product can be released

RESULTS

After doing the heuristic evaluation of the Hamava system, each of the evaluators identified 43, 46, 39, and 48 problems respectively, and after combining and summarizing the problems identified by the three evaluators and removing duplicates, a total of 176 problems remained. The highest level of problem was related to the violation of the two principles of aesthetic and minimalist design (n=58), user control and freedom (n=31), (Fig 1). And the least problem related to the recognition rather than recall principle with a severity of two (Table 3). The rate of agreement between the assessors was also 81 percent.

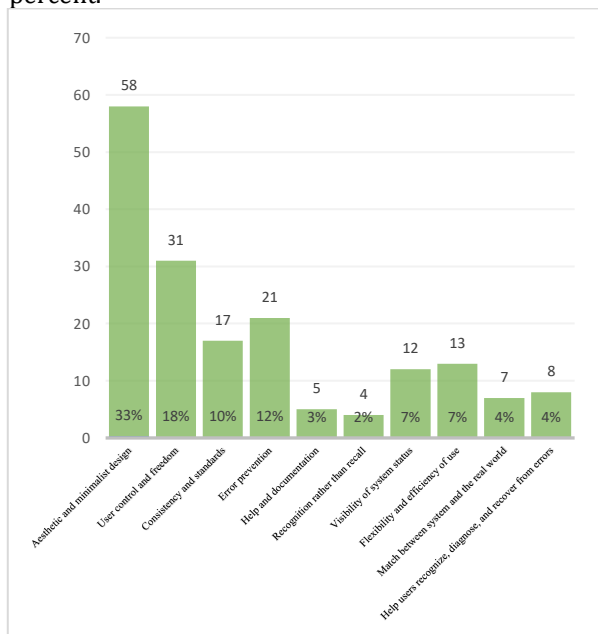


Fig 1: Comparison of the number of problems found based on Nielsen's ten principles

Cases related to the violation of aesthetics and minimalist design were among the indicators that were seen in the design of different parts of the system and accounted for the most recognized problems. Not using an attractive color palette, indecorous design of the website structure, crowded personal information page and large design of related boxes, unbalanced arrangement of icons, failure to consider content hierarchy and inappropriate use of white space, use of long titles due to the space limitation that a part of the text could not be read, the poor and aimless design of the menu which caused the user to be confused, the failure to display the full screen and the failure to use the appropriate font which can reduce the website's interaction rate were among these things that according to the evaluators, it was assigned a severity level of two. Furthermore, the information in this system was not displayed on mobile phones and tablets as clearly as it is displayed on the computer.

Users regularly make mistakes when working with the system, and it is essential that they can get rid of the mistake by choosing the right option. This component is considered a feature of user control and freedom. For instance, there is no section for adding or deleting courses, and there is no back button on each page to remove and add the desired courses in the Hamava system, and after each click on the button, it takes us to the first page (login to the system) that reduce the speed of the user. A cancel link that allows the user to exit a task or multi-step process is not provided in this system. Likewise, an undo option (and a corresponding redo option) that allows users to back out of changes in an activity is not built into the Hamava system. These problems were assigned a level of severity of four.

Table 3: Mean severity scores, number of problems, and examples from the heuristic evaluations

Principles of heuristic evaluation	Average severity	Number of problems	Example
1. Visibility of system status	2	12	The system did not give the user proper feedback to confirm or reject the action taken
2. Match between the system and the real world	2	7	In the design of this system, words like "academic profile" were used, which is not a common word in educational terms.
3. User control and freedom	4	31	There is no section for adding or deleting courses, and there is no back button on each page to remove and add the desired courses
4. Consistency and standards	4	17	Persian items are placed on the left side in some parts
5. Error prevention	4	21	The traditional error message images such as bold and red text were not used, and when an error occurs, it does not offer users a solution to correct the error
6. Recognition rather than recall	1	4	In the course selection section, courses must be updated first, but the update item is designed in the academic profile section, and this has caused confusion and reduced speed
7. Flexibility and efficiency of use	3	13	The lack of customizing according to the content and functionality for users
8. Aesthetic and minimalist design	2	58	The information in this system was not displayed on mobile phones and tablets as clearly as it is displayed on the computer
9. Help users recognize, diagnose, and recover from errors	3	8	when entering unauthorized and out-of-range information, it does not warn the user to prevent registration errors
10. Help and documentation	4	5	Where necessary, the system does not provide any help

The problems related to non-compliance with the standard and consistency component were also seen in diverse parts of the system. Consistency is one of the most significant features of any particular system. The way relationships are organized and the way elements and patterns are presented should be consistent throughout the system. For instance, in the personal information section, two English-Persian icons are used for the information on the place of issue, while the rest of the items, they must be written in Persian. Furthermore, for some icons such as the report card and changing the password, a logo is considered but other icons are without a specific shape. Likewise, Persian items are placed on the left side in some parts. The evaluators assigned a severity of four to this problem.

Problems related to the error prevention component can be seen in different parts of the system. Good error messages are significant, but the best plans are to either prevent problems from occurring in the first place or eliminate error-prone conditions. By providing suggestions, using restrictions, and reducing workload, the system must stop unconscious errors. For instance, some examples of violations of this indicator were that if we enter non-numeric information in the phone or national code section of the personal information page, the error message would not be displayed. The traditional error message images such as bold and red text were not used, and when an error occurs, it does not offer users a solution to correct the error. This problem was given a severity level of four. The help and documentation component is not considered in any of the system parts, which assigned a severity level of four.

The system should decrease the user's memory load by exposing options, actions, and items. These items signify the recognition rather than recall component, which is considered one of Nielsen's ten principles. For instance, in the course selection section, courses must be updated first, but the update item is designed in the academic profile section, and this has caused confusion and reduced speed. This problem was given severity level 1.

According to the visibility component, the system should inform the user of what is being done through appropriate continuous feedback. Among the problems of this component was that in the majority of cases after registering the information, the system did not give the user proper feedback to confirm or reject the action taken. This problem was assigned a severity level of two.

The evaluators also identified problems in the Hamava system in line with the flexibility and efficiency of the use component. The system should have shortcuts that increase the speed of users and its absence in the system is known as a usability problem. One of the problems found in this area was

the lack of customizing according to the content and functionality for users, and in addition, no shortcuts were installed to facilitate the functions required by users. This problem was given a severity level of three.

Violation of the principle of matching the system with the real world can be seen in the design of diverse parts of the system. For instance, there should be a magnifying glass sign in the search section of the screen, but it is not considered in the design of the system. The evaluators assigned a severity of two to this problem. Similarly, in line with the design of systems, it should be ensured that users can understand the meanings and concepts used without the need to search for the definition of a word. While in the design of this system, words like "academic profile" were used, which is not a common word in educational terms.

The problems related to the good error message component in the system seem to be less than other components. For instance, when entering unauthorized and out-of-range information, it does not warn the user to prevent registration errors. This problem was given a severity level of three.

DISCUSSION

A total of 176 unique problems were identified in the evaluation of the university system of Hamava, most of which were relatively high in severity, which means that its correction is important and should be prioritized.

The results of this study revealed that the problem of aesthetic and minimalist design aspects was at least one of the most common problems in the design of the user interface of the present system. This problem reveals that the existing system must be designed and revised in such a way that only crucial items are considered in the design of the application, and the labels of the fields should be brief, familiar, and descriptive of the content.

In this regard, the study by Daramola et al. [21] aimed at heuristic evaluation of an institutional e-learning system showed that the e-learning system had strong credibility in terms of supporting web activities, good educational content, and e-learning features. However, it had problems with aesthetics, such as color combination and appearance, which should be improved.

The study by Miller et al. [22] aimed to examine the impacts of aesthetic design on learner experience in an e-assessment environment. It showed that students who worked in an online environment with advanced aesthetic design had better motivation and performance than those who worked with a low-aesthetic interface.

The study of Khajouei et al. [23] reported that

additional information in the information system, along with causing problems in the field of aesthetics and design, can cause disruption and decrease the speed of users.

The second problem recognized with a high frequency in this study was user control and freedom, which means that users should be completely free in choosing and performing tasks and the system should not force them to do a precise task. The results of Cho et al. [24] study in 2022 with the aim of heuristic evaluation of the usability of a clinical decision support system also approve the findings of this study. This issue disclosed that users have problems while using the software, which causes time wasting, confusion, and failure to attain their goals while working with the system.

The results of the present study are in line with those of Davids et al. [25], who identified 22 problems in their study aimed at improving the usability of e-learning resources using heuristic evaluation. Among these problems, the ones related to user control and freedom, visibility of system status, match with the real world, intuitive visual layout, consistency and conformity to standards, aesthetic and minimalist design, error prevention and tolerance, and help and documentation were considered serious.

In this regard, Ssemugabi [15] revealed that some of the problems identified by the heuristic evaluation method in e-learning applications were related to the aspect of user control and freedom. For example, these applications lacked facilities for Undo and Redo and the logout button. Also, printing site content, such as the learner's guide and content modules, was not easy in these applications.

Likewise, the results of Dowding et al. [26] to develop a heuristic evaluation for dashboard visualization revealed that user control and freedom with the degree of severity of three is one of the important problems. This study reported that some aspect related to the field of user control and freedom is the presence of the emergency exit button in the system. Likewise, users must be able to easily move back and forth between screens.

The third problem identified with high frequency was error prevention with a severity level of four. This problem designates that the existing system must be designed and adjusted in such a way that there is an error prevention capability. Likewise, the error messages should inform the user of the severity and cause of the error and help the user in correcting the error [27]. The results of the study by Khajouei et al. [23] to compare heuristic and cognitive evaluation methods for evaluating information systems designated that error messages should be in simple language without code and show exactly the problem. In this study, 10 problems (77%) were related to error prevention.

The next problem that was identified with a severity level of four was consistency and standards. The use of standards in the system is obligatory and these standards must be similar and identical in the whole system. Formatting standards such as font size, type, style, color, and margin should be observed through the system. Each window must have a precise title. Similarly, if the system has multiple data recording pages, all pages must have the same title [28]. Generally, this principle refers to the fact that users should not wonder whether different words, situations, or actions have the same meaning or not when working with the system [27]. The help and documentation component are not considered in any part of the system, which is assigned a severity level of four. Studies, in agreement with the results of the present study, have shown that the designers of the hospital information system (HIS) do not pay the necessary attention to the help and documentation component and may consider it an unnecessary and secondary function [29]. Since the guide in information systems can help educate users and its absence or weakness can lead to user confusion when interacting with the system, system designers must focus on the importance of this issue.

In this regard, Zaharias's study [30] aimed at heuristic evaluation of e-learning courses showed that some of the problems of these systems were low accessibility and lack of communication tools, such as job aids. This study further claimed that these problems were common in many other e-learning environments that focused too much on technical development and ignored issues related to pedagogical usability, accessibility, and other particular e-learning design issues. Therefore, it is suggested to use the Web Content Accessibility Guidelines (WCAG) for the design of educational systems and evaluate the usability of these systems [31].

Since university systems are faced with a large number of users, including employees, students, and faculty members, identifying problems and solving them can lead to the satisfaction of a wide range of users. If the user interface problems recognized in this study are resolved in the Hamava system and their usability is improved, the end users of the systems will need less support from companies or university IT professionals. Likewise, the results of the present study can help assistants and educational managers choose new educational systems with high usability.

The current study likewise has limitations. Since the heuristic evaluation is done only by expert evaluators without the participation of real users, the real problems of users with the system may not be identified in this method. To decrease this limitation, the evaluators are selected from among the people interacting with this system and in contact with real

users and familiar with their issues.

CONCLUSION

Based on the results of the present study, usability problems such as aesthetics and minimalist design, user control and freedom, error prevention, and consistency and standards were among the most important problems that, if not solved, could lead to an increase in errors, user dissatisfaction, reduced quality of information, wasted users' time, and ineffective interaction with the educational system. Considering the wide range and ease of use of mobile phones, it is suggested that the system clarity should be designed in such a way that students' affairs can be easily tracked using mobile phones and tablets. It is also recommended to control large boxes, long titles, and inappropriate use of white spaces to comply with aesthetic principles. Concerning the component of user control and freedom, it is suggested to have a back button on every page and the possibility of canceling the activity. In line with consistency and standards, it is recommended to use the Persian language throughout the system and the appropriate logo for all icons. The arrangement of all fields should be observed in the same way and according to the standard on all pages. In line with the error prevention component, it is recommended to have appropriate error messages along with necessary activities to correct the error. Considering that the Hamava system does not have the help and documentation component, and on the other hand, the users of this system frequently encounter questions during their work with the system, which may not be possible for them to access and contact the system manager at any time of the day or night,

therefore, the user guidance feature should be considered in the system.

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AUTHOR'S CONTRIBUTION

FB: Conceptualization, writing original draft, evaluate the Hamava system; FS: writing original draft, evaluate the Hamava system; EE: writing original draft, evaluate the Hamava system, review and editing; AA: writing original draft, evaluate the Hamava system; AS: conceptualization, writing original draft, review, and editing, evaluate the Hamava system.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

FINANCIAL DISCLOSURE

No financial interests related to the material of this manuscript have been declared.

ETHICS APPROVAL

This study was approved by the researcher's institute review board at Birjand University of Medical Sciences. The approval code number was IR.BUMS.REC.1401.418.

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