The Relationship Between the Usability of Research Centers’ System and Mental Workload Caused by Its Interaction with Users of Shiraz University of Medical Sciences

Reza Kazemi, Assistant professor, school of health, Department of Ergonomics, Shiraz University of Medical Sciences, Shiraz, Iran.

Zeinab Rasouli Kahaki, (*Corresponding author), Student of ergonomics, Department of Ergonomics, Shiraz University of Medical Sciences, Shiraz, Iran. Rasouli96@gmail.com

Akram Sadat Jafari Roodbandi, PhD by Research Student of ergonomics, Research Center of Health Sciences, Institute of Health, Shiraz University of Medical Sciences, Shiraz, Iran.

Abstract

Background and aims: Websites are becoming the key for organizational survival in the global competition. Meanwhile, the university websites are considered as a necessary tool for the reflection of research activities, and they must have a structure to respond to the needs of users. Otherwise, users can suffer from mental pressures due to the design and complexity of the system. The purpose of this study was to evaluate the relationship between the research centers’ system usability of Shiraz University of Medical Sciences, and users’ mental workload in three tasks of sending, reviewing and supervising the research projects.

Methods: In this descriptive-analytic cross-sectional study, 35 faculty members of Shiraz University of Medical Sciences have participated. The data were collected by three questionnaires: NASA-TLX, System Usability Scale and Nilsson, for evaluating the mental workload and usability. Data analysis was done through 21SPSS.

Results: 60% of the participants were women. The SUS for all three tasks was lower and equal to 50. The average total score of NASA-TLX was 49.8 and based on this score, the highest and lowest scores were related to the performance and physical effort. The relationship between the NASA-TLX index and the final score of SUS was significant (p <0.001). Using Nilsson's questionnaire, it was concluded that in redesigning the system, it is necessary to modify the efficiency and flexibility dimensions.

Conclusion: The results showed that by increasing the usability of the system, the workload will be reduced. It is suggested that, as an important feature in improving the human-computer interaction, more consideration should be given to usability in the software systems' design.

Conflicts of interest: None

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INTRODUCTION

Websites and systems are becoming the key to the organization's survival in global competition. An organization's website can portray the perspective and values of that organization (1). Because of its many benefits, such as organizing, exchanging, interacting, and reducing the time to access information, it holds the largest possible amount of information based on the organization's goals. Thus, the proper design of a website and its systems can enhance its success in increasing its usability, revisiting the site, trusting and improving the users' performance, and conversely, its poor design can eventually lead to the website's failure (2). One of the solutions that have been proposed and developed to simplify the use of systems and adapt them to the needs of users, is the usability issue. According to the ISO 9241’s definition, usability is the value that a product can be used by certain users to achieve a certain goal and besides the effectiveness and efficiency, user satisfaction should be achieved (3). Usability tests are used to measure the usability of a product or system, which can be carried out in a variety of ways, including the System Usability Scale (SUS) questionnaire (4). Nielsen's (1990) method is also one of the most famous usability methods in which, 3-5 evaluators will be assigned to examine the connection of the user, and judge its compliance based on the standard principles (5). Due to the design and complexity of the work, users may experience psychological problems while they are using the system and website. Therefore, web designers tend to use mindfulness assessment techniques to collect the user's feedbacks. In cognitive and ergonomic psychology, mental workload refers to the amount of perceived effort caused by a particular activity (6). Generally speaking, mental and objective methods can be considered as important methods for evaluating the workload in a system. One of the most well-known tools with a mental approach, is the NASA-TLX index, which is completed by the operator in the form of a questionnaire (7). Most of the studies, especially in the field of ergonomics, have taken the idea that the mental workload can hurt the users' performance. In the context of website and system design, the mental workload is regarded as an important criterion for designing. Examining people's interactions with computers and other technologies, should be considered as an important issue. Improper system design can cause a lot of mental workload for users (8). Organizations, universities, educational, and research centers around the world, take advantage of the internet potentials to develop and complete their knowledge. Therefore, university websites are considered as an essential platform for reflecting researches, educational and administrative activities (9).

The Research Management System has been launched as a comprehensive tool in many universities in the country, which enables researchers to go through research processes in less time. Accordingly, not only the speed of research project progress will be increased, but also organizational bureaucracies for carrying out the implementation stages including sending, reviewing, judging, project status of a research project, dissertation, article, and other cases in the office of the vice-principal researcher, will be facilitated. Due to the importance and few studies on this area of research, this study was conducted to investigate the relationship between the Research Management System usability of Shiraz University of Medical Sciences and the users’ mental workload, considering the three tasks of sending, reviewing, and supervision of the research projects.

METHODOLOGY

In this descriptive-analytic cross-sectional study, 35 faculty members of Shiraz University of Medical Sciences have participated. Studies show that 8 to 25 samples will be sufficient for testing the usability (10).

The inclusion criteria, were all faculty members who performed all the three tasks of submitting, reviewing, and supervising the project at least once in the last year. The data collection tools included three questionnaires of mental loading index, system usability scale, and Nilsson questionnaire for mental loading and applicability.

1. The NASA Task Load Index is a popular technique, subjective and multidimensional assessment tool that rates the perceived workload to assess a task, system, or team's effectiveness or other aspects of performance. NASA-TLX uses six questions to assess the mental demand, physical demand, temporal demand, performance, effort, and frustration. Each of these scales is characterized by definitions such as low/high. That is, the lowest score is zero and the highest score is 20. To calculate the mental load, from the obtained values of the six dimensions of the questionnaire, the average is obtained and the number is multiplied by 5, and the final score (in the range of 1 to 100) is indicative of the overall mental workload. The
score that is closer to 100, indicates a higher mental workload (11). This scale has been used in various fields, including aviation, healthcare, and other complex socio-technical fields (11). The validity and reliability of this questionnaire has been confirmed in Iran by Mohammadi et al. (12).

2. The System Usability Scale (SUS) questionnaire is simple and gives a global view of subjective assessments of usability. It consists of a 10 sentence questionnaire with five response options for respondents; from strongly agree [1] to strongly disagree [5]. The sentences are alternately positive and negative, respectively. To calculate, the odd sentences were subtracted from 1 and the even sentences are subtracted from 5, and their sum is multiplied by 2.5, which is a number between 1 and 100. The closer this number is to 100, the better the usability is. Diant et al. Obtained the Cronbach’s alpha coefficient of the questionnaire as 0.79, and the reliability coefficient as 0.96 (13).

3. The Nielsen heuristic evaluation, is a “discount usability engineering” method for evaluating the user’s interfaces to find their usability problems. This method uses 10 key components to evaluate the information system, that includes: visibility of the system’s status, the match between the system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimalist design; it helps the users recognize, diagnose, and recover from errors, help, and documentation (5).

In this study, three experts including a medical informatics master, information technology master, and one faculty member familiar with information systems, performed the Nielsen evaluation. To complete the questionnaires, participants were asked to enter all the three user environments and complete the questionnaire after each step. Data analysis was done through the SPSS software 21.

RESULT

Based on the analysis, 60% of the participants were female, and the average work experience was 5 years, ranging from 1 to 20 years. The SUS for all three tasks of sending, reviewing and supervision of the research projects, was lower and equal to 50. This value indicates that the usability of the system is low. Of these, the score associated to the task of supervising the project is the highest. According to the one-way analysis of variance, no significant relationship was found in the system usability, between the three tasks of sending, reviewing and supervision of the research project in Pazhoheshiar system (p = 0.8). The average total score of NASA-TLX was 49.8. The score was obtained on a scale of 0 to 100, which indicates a relatively high workload, and based on this, the highest and lowest scores were related to the performance and physical effort, respectively. The relationship between the NASA TLX index and the final score of SUS was significant and negative (p <0.001). This will reduce the workload by increasing the usability of the system.

The relationship between the NASA TLX index and the final SUS number is significant and negative (0.001). Thus, by increasing the usability of the system, its workload will decrease as well. The relationship between SUS and NASA-TLX index subsets, which was obtained by Pearson's correlation coefficient is presented in Table 1. The two dimensions of mental effort and frustration, are significantly related to the SUS questionnaire. That is, as the applicability decreases, the user's frustration and stress increases significantly. The T-Test analysis indicated that there was no significant relationship between gender and the usability score with the NASA-TLX index.

Among the ten options for the Nielson's method, there was no significant relationship between the three tasks of sending, judging, and monitoring. However, among the 10 components, the highest mean is related to flexibility and efficiency of use (3.2 ±0.9), and the lowest mean

| NASA –TLX Scales       | SUS Pearson correlation coefficient | P-value |
|------------------------|------------------------------------|---------|
| Mental Demand          | -0.43                              | 0.001*  |
| Physical Demand        | -0.01                              | 0.87    |
| Temporal Demand        | -0.18                              | 0.08    |
| Performance            | 0.08                               | 0.4     |
| Effort                 | 0.11                               | 0.2     |
| Frustration            | -0.50                              | 0.001*  |
is related to the diagnosis instead of the reminder (1.6 ±1.4).

**DISCUSSION**

This study was aimed to investigate the mental workload and applicability of the research management system of Shiraz University of Medical Sciences. The results showed that the average applicability score is less than 50, and this value represents the low usability of the system. Applicability is considered as a qualitative feature in website and system designing (14). It seems that modifying and redesigning the system based on ergonomic principles, can be useful in improving the employee's performance. A review of related literatures, suggested that ergonomic principles in the designing of websites, such as information grouping based on format, feedback, readability, conclusion, minimum activity, flexibility and the user's experience, play an important role in the usability of websites (15). The results of a study by Agharezaei and his colleagues, showed that the laboratory information system used in some hospitals of the country, has many usability problems and if it is not solved, it will lead to performance deficiency, error increase, and user confusion (16). It should be noted that the applicability assessment has been performed by different methods. The discrepancy is mainly due to the different choice of methods. The system's design is also carried out based on different standards. According to the results of the NASA-TLX questionnaire, the overall average score of this study's mental workload was 49.8, between the scales of 0 to 100, which indicates a relatively high workload. Pachanka et al. (2019) examined the mental workload of users of the individual health care system, using the NASA-TLX questionnaire. The results were in line with this study and showed that the improper design imposes a high level of workload on users (17). In the study of examining the dimensions of the questionnaire in this study, it seems that the inefficiency of the system imposes the highest amount of workload on the individual, and as the person does not bear any special physical effort, the lowest score is assigned to this dimension. It is worth mentioning that according to Nielson's assessment conducted by experts, the flexibility and efficiency of use, assign the highest score respectively. The big problems attributed to Nilsson's definition, should be taken into consideration and should be modified. In the present study, the relationship between the NASA-TLX index and the SUS questionnaire score was significant (0.001). In another study by Lango, no significant relationship between the SUS questionnaire and the NASA-TLX questionnaire was found, which could be derived from different environments (8). The pearson's correlation coefficient indicated that there was a significant relationship between SUS and the two dimensions of mental effort and frustration. This means that as the usability decreases, frustration and stress increase. Therefore, it is essential to take basic steps to identify the factors that increase frustration and stress, to improve the system's usability.

In this study, a questionnaire was conducted to collect data, so some people may have refused to provide an accurate answer. For further researches, it is recommended that for the future studies, interviews could be used to compare and contrast the results of the questionnaires.

**CONCLUSIONS**

The research findings showed that by increasing the usability of the system, the workload will decrease as well. It is recommended that all the modifications in the later versions of the system should be corrected. The use of identified cases in designing similar systems should be prevented too. Therefore, applicability should be considered as an important design criterion in improving the human–computer interaction.

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**CONFLICT OF INTEREST**

The authors declare that there are no conflicts of interest.

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مشکلات کاربران استفاده کردن (۱۶).

کاربر ممکن است در حین استفاده از سامانه و وب سایت تحت تاثیر طراحی و یکپارچگی کار دچار فشار روانی شود. به همین دلیل، طراحان و تجویزگری‌ها از ارزیابی قابلیت دهدی برای جمع آوری اطلاعات ضروری پیروی از عناصر کاهش در آواری، با روش‌های محاسباتی در این شرایط، با توجه به قابلیت‌های کاربران، می‌توانند این مطالعات برای ارزیابی بیشتری از طرح، در سایر موارد، از جمله در سایت‌های آزمایشگاهی، به کار برده شوند.

در این مطالعه، تأکید گردیده است که مطالعات بشری باید به‌صورت مناسب و به‌بهانه و به‌روش‌های مناسب انجام شود. به‌طور کلی، این مطالعات به‌عنوان یک مطالعه پژوهشی در حوزه‌های مختلف نهایی به‌صورت مناسب و به‌بهانه و به‌روش‌های مناسب انجام شده است. در این مطالعه، تأکید گردیده است که مطالعات بشری باید به‌صورت مناسب و به‌بهانه و به‌روش‌های مناسب انجام شود. به‌طور کلی، این مطالعات به‌عنوان یک مطالعه پژوهشی در حوزه‌های مختلف نهایی به‌صورت مناسب و به‌بهانه و به‌روش‌های مناسب انجام شده است.
این پرسشنامه شامل 10 جمله است که در یک مقياس 5 تا 1 نمره یکی به ترتیب از نمره یک به معنای کمال موافقت تا 5 به معنای کمال مخالفت تشكل شده است. جملات بصورت متناوب مثبت و منفی به ترتیب قرار گرفته اند. جهت محاسبه نیز جملات فرد از عدد یک تا 5، درصد می‌شود. این کمیت از سوی کاربر باید بهترین پاسخی را انتخاب کند. این پرسشنامه تکمیل از سوی کاربر پزشکی مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. مقدار انتخاب شده از 0 تا 25 می‌باشد که در نهایت 25 پرسشنامه تکمیل کاربر، ارزیابی می‌کند. این پرسشنامه تکمیل ۹۷ درصد از شرکت کنندگان بررسی بررسی محققان از ۸۰ سال اجتماعی انتخاب شده و در نهایت ۲۵ پرسشنامه تکمیل کاربرهای مختلف از مقطعی شد از سوی کاربر تکمیل شده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه NTLX (NASATLX) شاخص پزشکی ناسا مسئولیت سیستم روش بررسی - تحلیلی، اعضا حیات علمی دانشگاه علوم پزشکی شیراز جامعه آماری را تشکیل داده است. این مطالعه در تیم‌نامه سال ۷۴ انجام پذیرش فاکتور است. نمونه‌ها ۴۰ نفر از اساتید دانشگاه بیمارستان و تغذیه دانشکده توانبخشی و دانشگاه یزدیکی به‌کار برده شدند که به‌کاربردی بوده و نمونه‌ی در دسترس انتخاب شده است. این پرسشنامه تکمیل ۳۵ سال اجتماعی انتخاب شده است. این پرسشنامه محققان از ۸۰ سال اجتماعی انتخاب شده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه نیلسون تعلیق گردیده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه NTLX (NASATLX) شاخص پزشکی ناسا مسئولیت سیستم روش بررسی - تحلیلی، اعضا حیات علمی دانشگاه علوم پزشکی شیراز جامعه آماری را تشکیل داده است. این مطالعه در تیم‌نامه سال ۷۴ انجام پذیرش فاکتور است. نمونه‌ها ۴۰ نفر از اساتید دانشگاه بیمارستان و تغذیه دانشکده توانبخشی و دانشگاه یزدیکی به‌کار برده شدند که به‌کاربردی بوده و نمونه‌ی در دسترس انتخاب شده است. این پرسشنامه تکمیل ۳۵ سال اجتماعی انتخاب شده است. این پرسشنامه محققان از ۸۰ سال اجتماعی انتخاب شده است. این پرسشنامه شامل ۳۵ جمله مشابه به‌سازگاری به پرسشنامه NTLX (NASATLX) شاخص پزشکی ناسا مسئولیت SUTS (SUS) در ارزیابی با برسی کاربردی پذیری استفاده شده است.
در جدول ۳ داده‌های مرتبط با شاخص با رگرسیون ذهنی به ترتیب بر اساس تفاوت آزمون‌های شاهد است. که در این مطالعه بازاری در دو طرح و تلاش فیزیکی در ارسال طرح به ویژه برخوردداری و کمترین امتیاز را به خود اختصاص داده‌اند.

ارتباط بین NASA-TLX و SUS: مبنای قابل قبولی تفاوت ذهنی و سرخوردگی با رابطه معنی‌دار در میان تفاوت دانش درصدی است. بنابراین تعادل که با تفاوت کاربرد پذیری ساخته می‌باشد که با کارایی کاهش افتاده و تفاوت ذهنی و سرخوردگی در طبق جدول زیر بودند. که در این مطالعه به تفاوت ذهنی و سرخوردگی رابطه معنی‌دار با رابطه نهایی SUS جدول داده شده. بنابراین تعادل که هم‌چنین کاربردی‌تر باشد که می‌باشد با رابطه معنی‌داری بین سرخوردگی و فشار ذهنی نیز افزایش می‌یابد.

جدول ۱. امتیاز پرسشنامه SUS در سه وظیفه ارسال، داوری و نظارت تحقیقاتی (۰-۱۰)

| وظیفه مورد نظر | امتیاز | بینش | گزارشات | جدول (۱) | گزارشات | گزارشات | گزارشات | گزارشات | گزارشات |
|----------------|--------|-------|----------|-----------|----------|----------|----------|----------|----------|
| ارسال طرح | ۴/۱۸ | ۴/۱۸ | ۴/۱۸ | ۴/۱۸ | ۴/۱۸ | ۴/۱۸ | ۴/۱۸ | ۴/۱۸ | ۴/۱۸ |
| نظارت طرح | ۲/۲۰ | ۲/۲۰ | ۲/۲۰ | ۲/۲۰ | ۲/۲۰ | ۲/۲۰ | ۲/۲۰ | ۲/۲۰ | ۲/۲۰ |

جدول ۲: امتیاز پرسشنامه NASA-TLX

| کلی (۳۵) | نامه‌های مختلف | امتیاز | میانگین | انحراف معیار | میانگین | طرح | طرح | طرح |
|-----------|---------------|--------|---------|-------------|---------|------|------|------|
| کاری     | ۶/۱۵           | ۶/۱۵   | ۶/۱۵    | ۶/۱۵        | ۶/۱۵    | ۶/۱۵ | ۶/۱۵ | ۶/۱۵ |
| سرخوردگی | ۸/۸            | ۸/۸    | ۸/۸     | ۸/۸         | ۸/۸     | ۸/۸  | ۸/۸  | ۸/۸  |

جدول ۳: امتیاز پرسشنامه NASA-TLX

| میانگین | نامه‌های مختلف | امتیاز | میانگین | انحراف معیار | میانگین | طرح | طرح | طرح |
|--------|---------------|--------|---------|-------------|---------|------|------|------|
| دروازه طرح | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ |
| نظارت طرح | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ |
| طرح | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ | ۱۰/۱۰ |

رنگ کلامی و همکاران
بررسی ارتباط کاربردپذیری سامانه مدیریت امور پژوهش و مطالعات با فرهنگی اساس‌های سازگاری در گزارش. همچنین با استفاده از روش آنالیز T-Test همکاران، باعث شد که رابطه میانهای سیستم‌های اطلاعاتی با نمره کاربردپذیری و شاخه مطالعات نهایی انجام داده شود. 

جدول ۴: رابطه میان شاخص خاصیت SUS و NASA-TLX

| ایاد ناخص | خضروف همبستگی پرسون |
|-----------|------------------------|
| 0.01      | تلاش نهی
| 0.07      | تلاش فیزیکی
| 0.08      | فشار روانی
| 0.06      | کاربرد
| 0.09      | تلاش
| 0.03      | سردردگی

جدول ۵: امتیاز ابعاد دهگانه پرسشنامه نیلسون (۲۰۰۲)

| ایاد پرسشنامه نیلسون | امتیاز فقط در حالات
|------------------------|------------------------|
| خواص                   | حداکثر
| محاسبه                  | میانگین
| سیستم کاربردی         | ۱/۴
| نظام کاربردی           | ۱/۲
| استادیت کاربردی        | ۱/۳
| تکنیک نوین            | ۱/۴
| فناوری پیشرفته         | ۱/۳
| راهنما و سمت هماهنگ | ۱/۴

بحث

هدف از انجام این مطالعه بررسی اثر کاربردپذیری و کاربردپذیری سیستم پژوهشگاهی دانشگاه علوم پزشکی شریعت به کنار همکاران، باعث شد که رابطه علمی به کاربردپذیری کمتر از ۵۰ می‌باشد و بنابراین نماینده کاربردپذیری پایین سامانه است. کاربردپذیری اصل کلیدی طراحی و ساخت و سازمان است که به عنوان یک ویژگی کیفی در نظر گرفته شده است (۱۴). به نظر اصل و طراحی مجدد سامانه با اساس اصول ارگونومی می‌باشد.
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