



User Satisfaction and Components of Perceived Usability for a Course Management Software

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Abstract

Course Management Software (CMS) have become integral parts of educational technology. CMS are widely used in educational institutions for many purposes such as providing access to course material and effective online communication. User satisfaction for CMS determines the value of these tools and affects quality of the education. Usability is one of the numerous factors that have been found to be related with user satisfaction for information systems. Usability is not a singular measure and includes various components such as quality of information presented or interface design. The insights into the relation between different components of usability and user satisfaction could inform CMS designers and educational technology managers on how to improve their products and to contribute to more effective use of these tools. The current study explored the relation between user satisfaction and components of perceived usability for a CMS using the Turkish version of the Computer System Usability Questionnaire Short Version (T-CSUQ-SV) among the students of a military educational institution. The regression analysis demonstrated significant positive relations between user satisfaction and all three components of perceived usability that the T-CSUQ-SV measured; systems usefulness, information quality, and interface quality. Among them, interface quality was the most influential predictor of user satisfaction.

Keywords: Usability, Course Management Software, User Satisfaction

Introduction

Course Management Software (CMS) has been widely used in educational institutions worldwide [1,2,3,15,16]. 2002-2003 statistics showed that in the USA, CMS was used in 94 % of the universities [1]. Main purposes for using CMS include; providing students easy access to course material, enabling and improving teacher-student communication, making course related announcements, grading, and exams [1-3,16]. Studies suggest that CMS are used more heavily for knowledge sharing than communication [2]. Jones ve Jones [1] reported that, in a university in USA, 80% of instructors and 93% of students found the CMS used in the university beneficial for learning. The use of CMS has been found to facilitate collaboration between instructors and students, to contribute to computer skills of students, and to save time for academicians [1,2]. According to Yohon et al [2], the faculty who adopted the CMS used in their university reported that using the CMS improved their teaching. Development and implementation of the CMS in an educational institution entails significant financial investment and organizational effort. In addition, the CMS should be accepted and extensively used by the students and faculty reap its benefits and to contribute to the quality of education. For acceptance and effective use of the CMS, user satisfaction among target audience should be ensured.

User satisfaction is a basic measure for the effectiveness and quality of the information systems [19,20]. The baseline is that target audience will effectively use an information system only when they are satisfied with it. Authors supported that satisfaction is a subjective construct and involves user's attitude and perception toward a system [19]. Furthermore, the literature provides ample evidence that user satisfaction is multi-faceted; many aspects of an information system such as content, accuracy, reliability, accessibility and ease of use influence and shape user satisfaction [19,20]. For example, Lee and Kim [19] built an overall user satisfaction model using information satisfaction (i.e. content, accuracy, format, timeliness) and system satisfaction (i.e. ease of use, user interface), and evaluated user satisfaction for web based information systems used in the Korean universities.

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Their model was significant and explained 50.4% of the variance in overall user satisfaction [19]. Models related to user satisfaction for various types of information systems commonly include items that measure usability (e.g. ease of use, navigation) as it directly affects user performance and perception toward a system [19-22]. Udo et al [21] found that web content construct including several usability items (e.g. appealing graphics, ease of navigation) was significantly related to web service quality which predicted user satisfaction. Widely used in e-service field to measure e-service quality is the E-S-QUAL model by Parasuraman et al [22], and this model includes number of usability related items within its efficiency construct (e.g. it enables me to complete a transaction quickly).

The inclusion of usability related items in abovementioned models indicates significance of usability in attaining user satisfaction. Likewise, studies highlighted the importance of usability in educational software, and usability of CMS was found essential for user performance, user satisfaction and education quality [2,3,15-17]. Monaco [15] propounded that usability can increase the value and use of the CMS. Johnson et al [13] applied heuristic evaluation and Questionnaire for User Interaction Satisfaction (QUIS) [13] among informatics students to assess usability of Prometheus (i.e., the CMS developed in George Washington University, USA), before and after interface improvements. While participants reported to be satisfied with ability to learn complex systems the most, manuals and online help was the least satisfactory aspect of interaction. Ramakrisnan et al [14] highlighted the importance of user interface design for learning management systems (LMS). They evaluated the interface design of a LMS via eye tracking and interview techniques, and developed improvement alternatives. Daneshmandnia [16] assessed the usability of Moodle, a widely used CMS, using expert reviews and surveys based on seven characteristics: learnability, operationability, efficiency, memorability, errors, satisfaction and attractiveness. Respondents showed the highest agreement above 30% on learnability, memorability and attractiveness of the Moodle. Rosato et al [17] evaluated and compared usability of three CMS; WebCT, Sakai and Moodle using effectiveness, efficiency and satisfaction measures such as error rate, completion rate and modified System Usability Scale (SUS) [13] respectively. They recommended that CMS interface should follow web-usability conventions (e.g.back button) to be more intuitive. Two studies assessed usability of CMS used in Turkish universities [5,6]. Ersoy identified through user tests potential usability problems of a CMS developed in Middle East Technical University [5], and Karahoca et al [6] explored the relationship between usability level of a CMS and cognitive abilities and individual differences of the students. Yohon et al [2] explored adoption of the CMS they used in their university and stressed that usability of the CMS should be evaluated to pinpoint potential usability problems that could adversely affect adoption of the tool by faculty and students.

Usability is a multi-dimensional construct [7-10,18] and different components (e.g. navigation, interface design) can affect user satisfaction differently. Furthermore, usability is evaluated via objective (i.e. performance related; such as task completion rate, error rate), as well as subjective (i.e. perceived usability) measures. Perceived usability provides important insights into how users subjectively view and feel about the usability of the system. While studies highlighted the importance of usability for user performance on the CMS, understanding the effects of different components of usability on user satisfaction appears to need further exploration. It can be suggested that perceived usability and user satisfaction are both subjective measures and could be related such that better perceived usability could lead to higher user satisfaction. Abovementioned studies mostly concentrated on evaluating the usability of CMS, satisfaction of users with interaction features, and effects of usability improvements. However, the studies neither addressed overall user satisfaction nor attempted to establish relationship between components of perceived usability and user satisfaction. The findings in this avenue could inform CMS designers as to which usability component is more influential on user satisfaction.

The current study explored the relationship between user satisfaction and components of perceived usability for a CMS, and thereby attempted to establish predictive relationship between usability perceptions and user satisfaction.



Materials and methods

CMS under study

The CMS under study is developed in-house in a military educational institution and has been in use for three years. It is the official CMS for all courses, thus, all students are required to use it. The CMS enables instructors to use predesigned pages for many purposes such as; sharing course material (e.g. course notes, presentation), announcements, uploading homeworks and exam solutions. The material can be shared for each week separately. The students are required to sign in and follow the course activities on the CMS (e.g. accessing course material, following announcements). They can submit their works (e.g. class projects) to their instructor using the CMS, thereby CMS forms the main communication and knowledge sharing medium. The CMS is considered to increase efficiency in course management, to facilitate instructor-student communication and to improve quality of academic education and therefore extensively used by both instructors and students.

Data collection instrument

Turkish - Computer System Usability Questionnaire Short Version (T-CSUQ-SV) was used to collect perceived usability data. The CSUQ was originally developed and validated by Lewis [9], and adapted and validated in Turkish language by Erdinc and Lewis [10]. T-CSUQ-SV includes 13 positively structured statements. The first 12 items measure various aspects of usability. The last item measures overall user satisfaction, which makes T-CSUQ-SV a proper tool for the current study. The items are rated on a seven point scale ranging from “Strongly Agree (1)” to “Strongly Disagree (7)”. Higher ratings indicate i) lower usability levels for the first 12 items, ii) lower satisfaction for the last item. Table-1 shows the T-CSUQ-SV items.

Table 1. T-CSUQ-SV items and mean scores (std.dev.)

T-CSUQ-SV Items	Mean (std.dev.)
1. Overall I am satisfied with how easy it is to use CMS.	2.89 (1.64)
2. It is simple to use CMS.	2.61 (1.81)
3. I can effectively complete my work using CMS.	3.12 (1.54)
4. I feel comfortable using CMS.	2.98 (3.37)
5. It was easy to learn to use CMS.	2.41 (1.79)
6. I believe I became productive quickly using CMS.	3.67 (1.82)
7. CMS gives error messages that clearly tell me how to fix problems.	4.16 (1.77)
8. The information (such as online help, on-screen messages and other documentation) provided with CMS is clear.	3.26 (1.61)
9. The information provided by CMS is easy to understand.	2.93 (1.53)
10. The interface of CMS is pleasant.	3.86 (1.93)
11. I like using the interface of CMS.	3.87 (1.84)
12. CMS has all the functions and capabilities I expect it to have.	4.51 (1.56)
13. Overall, I am satisfied with CMS.	3.91 (1.65)

The first 12 items form three sub-scales, each of which measures a different component of usability; System Usefulness (SYSUSE), Information Quality (INFOQUAL) and Interface Quality (INTERQUAL). Table-2 shows the sub-scale structures.

The sub-scale structure allows analysis of perceived usability across these three usability components. The mean ratings across the items that comprise a sub-scale, gives the “sub-scale score”. T-CSUQ-SV items were fit onto a single page and questions to collect demographic data and CMS use profile data preceded T-CSUQ-SV items on the same page.



Table 2. T-CSUQ-SV sub-scales

Items	Subscale
1-6	System usefulness (SYSUSE)
7-9	Information quality (INFOQUAL)
10-12	Interface quality (INTERQUAL)
13	User satisfaction

Participants

The participant group included 110 students. The second and third authors collected data on T-CSUQ-SV forms among the students in different classes by convenience sampling. The criteria for inclusion in the evaluation were; i) voluntary participation to the study, ii) minimum one year of experience in using CMS, iii) being a native Turkish speaker. Based on the second criterion, first year students' data were excluded. Table-3 shows characteristics of the participant group.

Table 3. Characteristics of participant group

Age	
Range	5 (18-23)
Mean	20.8
Gender	
	<i>n</i> (%)
Male	102 (92.7)
Female	8 (7.3)
Year	
	<i>n</i> (%)
2	43 (39.1)
3	48 (43.6)
4	19 (17.3)

Table-4 shows the CMS use profile of the participants.

Table 4. CMS use profile of participant group

Purposes for using CMS (more than one answer was allowed)	
	<i>n</i> (%)
Accessing course material	103 (93.6)
Communication	27 (24.6)
Announcements	67 (60.9)
Homeworks	52 (47.3)
e-mail	80 (72.7)
Weekly CMS use frequency	
Mean (std. dev.)	6.5 (5.1)
Weekly CMS use duration (hour)	
Mean (std. dev.)	2.2 (3.4)

Results

Table-1 above includes the mean scores for T-CSUQ-SV items. Mean sub-scale scores, mean user satisfaction score, and Cronbach alpha values for scale reliability were given in Table-5. Cronbach alpha values for sub-scales ranged between 0.74-0.89, and it was 0.88 for the overall scale. Cronbach alpha > 0.7 is accepted satisfactory [11], therefore these alpha values indicated high scale reliability.

Table 5. T-CSUQ-SV sub-scale scores and scale reliability measures

Subscales	Mean (sd)	Cronbach alpha
System usefulness	2.90 (1.40)	0.89
Information quality	3.45 (1.32)	0.74
Interface quality	4.08 (1.58)	0.86
User satisfaction	3.91 (1.66)	

Overall: 0.88

System usefulness and interface quality had the lowest (2.90) and highest (4.08) mean scores respectively. According to Tukey test results, mean scores for all three sub-scales were significantly different ($p < 0,02$).

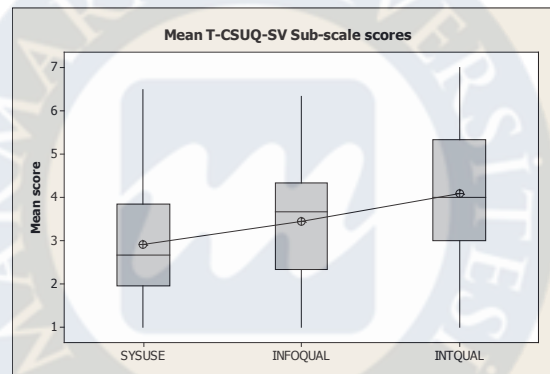


Figure 1. Mean sub-scale scores

A differentiation factor among the participants was the year of study (i.e. class). Potential effect of class was checked by performing one-way ANOVA on mean sub-scale scores and mean user satisfaction scores. The ANOVA results showed that class had a significant effect solely on mean INTERQUAL scores; the mean score of 2nd year cadets (4.50, std.dev. 1.60) was significantly higher ($p:0.029$) than the mean score of 3rd year cadets (3.64, std.dev. 1.52). No significant difference was found between other sub-scale mean scores ($p > 0.4$) and mean user satisfaction scores ($p:0.344$) across participant classes.

Relations between usability dimensions and user satisfaction was explored by i) correlations between sub-scale scores and user satisfaction score, ii) applying linear regression models with each sub-scale score as an independent variable (i.e. predictor), and user satisfaction score as the dependent variable. Table 6 gives correlation coefficients and significance levels. Correlation coefficients showed a positive significant relationship ($p < 0.05$) between sub-scale scores and user satisfaction; while the correlation level was low for system usefulness and information quality (coefficient < 0.5), interface quality had medium correlation ($0.5 < \text{coefficient} < 0.8$) with user satisfaction [12].

Table 6. Correlations between sub-scale and user satisfaction scores

Sub-scales	Correlation coefficients
System usefulness	0.41 ($p:0.000$)
Information quality	0.43 ($p:0.000$)
Interface quality	0.62 ($p:0.000$)

Three regression models were built for each sub-scale and user satisfaction. Table 7 shows β values (i.e. partial regression coefficients), t-test significance levels and R^2 values (i.e. coefficient of determination) for each model. β Values in regression models were positive and t-tests on β for each model showed all sub-scales had significant positive relations with user satisfaction ($p < 0.05$). R^2 values indicated that interface quality explained the highest percentage (38.3%) of variance in user satisfaction. These results supported that perceived usability significantly influenced user satisfaction, and the usability dimension

with the greatest effect was interface quality.

Table 7. Regression models

Predictor	β	R^2
System usefulness	0.48 ($p:0.000$)	16.7
Information quality	0.53 ($p:0.000$)	18.1
Interface quality	0.65 ($p:0.000$)	38.3

R^2 : Coefficient of determination

Figure-1 shows normal probability plots of residuals for three regression models. Kolmogorov-Smirnoff normality tests were performed on the residuals to check adequacy of the regression models. While residuals of the model with system usefulness slightly deviated from normality ($p: 0.01$), residuals in models with information quality and interface quality fitted normal distribution ($p:0.09$ and $p:0.098$ respectively). Visual inspection of the normal probability plots in Figure-2 supported normality of the residuals and model adequacy was accepted satisfactory.

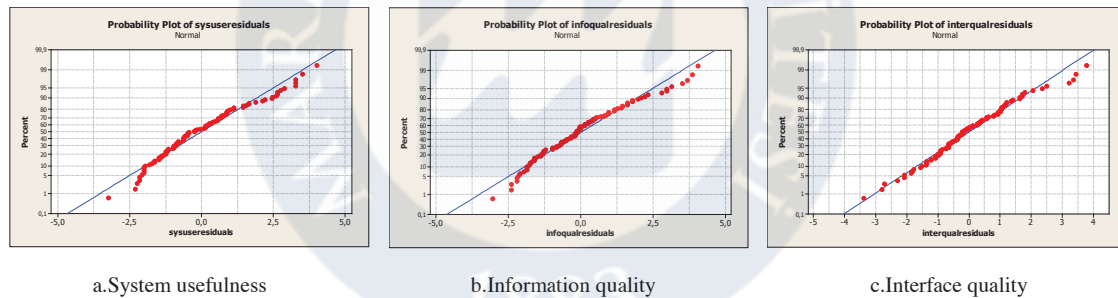


Figure 2. Normal probability plots for residuals for regression models

Discussion

The current study explored the relationship between user satisfaction and components of perceived usability for a CMS used in a military educational institution. Three components of perceived usability, measured by T-CSUQ-SV; system usefulness, information quality and interface quality were found to influence user satisfaction significantly. T-CSUQ-SV mean sub-scale scores for three components were significantly and positively correlated with user satisfaction scores.

The study extended previous research by empirically showing that perceived usability influenced user satisfaction. Further, the regression results showed that among the three components of usability, interface quality was the most significant predictor of user satisfaction. These results provided evidence for the role that usability plays in attaining user satisfaction. To increase effectiveness and facilitate acceptance of the CMS, developers and managers should take usability into account, evaluate and improve usability level of the CMS used in their institutions.

The strong relationship between interface quality and user satisfaction implies that interface design assumes particular importance for user satisfaction. Mean sub-scale scores showed the interface quality was rated as the poorest component of usability. The next step should be a usability evaluation focused on the CMS interface features. Detailed user tests coupled with interface-focused expert reviews could guide interface improvement efforts. The CMS under study was developed in-house, therefore the development team should review their design and ensure that the interface follows widely accepted web usability conventions [17].

The proven effect of usability in user satisfaction implies that quality researchers should integrate usability measurement tools and techniques into their toolbox to evaluate user satisfaction for information systems. Concurrent application of usability test methods with a quality measurement tool can provide insights into factors leading to poor user satisfaction and how to improve these factors [21,22].



T-CSUQ-SV is a recently adapted perceived usability assessment tool and it proved effective in the current study. Multi-component structure of the tool allowed authors to explore relations between different components of usability with user satisfaction. High Cronbach alpha values supported the reliability of the tool with Turkish speaking participants [10]. Also, inclusion of user satisfaction item expands the potential use and contribution of the tool in prospective quality studies, as well as usability research. Quality measurement models [e.g. E-SV-QUAL] can include CSUQ items to measure usability related quality aspects of the information systems (e.g. ease of use, navigation).

The study had certain limitations. Participant group included solely students, whereas faculty is also a part of target audience for the CMS. Perceived usability measures showed the relationships between usability components and user satisfaction in subjective terms. However particular usability problems that led to poor usability perceptions toward interface quality remained unexplored.

In addition to aforementioned extensions (e.g. using CSUQ for quality), future works can concentrate on two main avenues. Firstly, the CMS under study could be tested to identify usability problems, development team can improve the CMS in line with test findings, then replicate T-CSUQ-SV track the effects of the improvements on perceived usability as well as user satisfaction. Secondly, in parallel with the mobile expansion in information systems, mobile CMS applications should be developed in accordance with mobile usability principles. A mobile application can greatly increase the availability and effectiveness of the CMS among target audience. In addition, given "sharing" is a common behaviour among digital generation that forms the students population, future CMS should allow students to share their course-related ideas and findings using social media or similar platforms over the CMS such as forums. The results of the study indicated that all these potential improvement and expansions should take usability into account for high user satisfaction.

Conclusions

The study indicated that user satisfaction is significantly related to components of perceived usability. Interface quality was found to be the most influential predictor of user satisfaction. Better perceived usability can serve acceptance of the CMS by contributing to user satisfaction, thereby culminate in more effective use of investments that educational institutions make for CMS development and implementation. Therefore, usability of the CMS should be constantly evaluated, maintained and improved.

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