USERS' PERCEPTION OF OPEN SOURCE E-LEARNING PLATFORM QUALITY: THE CASE OF MOODLE

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ABSTRACT

Interest of scientific research on Open Source software and its development process is frequent. The number of research paper available and the number of tracks or workshops on this topic in most relevant IS Conferences is high. Due to its peculiar development process, Open Source software is deputed as capable of producing a better output if compared to traditional development environments. In traditional Open Source development processes the distinction between users and developers is blurred and these two figures may easily converge. On the base of this assumption, Open Source software started to spread in every sector, including e-learning. Anyhow, with the diffusion of Open Source software there is no warranty that users and developers still converge, therefore the assumption on the base of which the hypothesis that Open Source development processes contribute do a better output is no longer valid. The aim of this pilot study is therefore to investigate end users' quality perception on the Moodle Open Source e-learning platform (in terms of Usability, Functionality, Reliability, Efficiency and Quality in Use).

KEY WORDS

Qualità Issues of Web-based Education, Testing and Assessment Issues of WBE

1. Introduction

The interest of scientific research on Open Source software and its development process is directly witnessed by the body of research paper [1] and by the number of tracks or workshops devoted to this topic in most relevant IS Conferences (ie: ECIS 2007, ECIS 2008, Open Source Systems 2008 and IFIP WCC 2008).

Researchers acknowledge that Open Source software has a high impact potential on economic and social infrastructure [2]. On the base of the assumption that Open Source Software development processes contribute to a better output in comparison to traditional development methodologies [3, 4, 5], several studies started to investigate the adoption of Open Source based solutions in different environments [6, 7]. Large part of available studies focuses on the internal perspective of the Open Source software usage, without taking the end user into consideration.

On the base of these assumptions Open Source software usage is spreading in different contexts and environments, including e-learning. A frequently used Open Source software in e-learning contexts is the Moodle e-learning platform. Moodle is an Open Source development project that can rely on a large and stable community. According to the data publicly available on its website, Moodle is used in 199 countries with 46,773 registered installations, serving a total amount of (circa) 25 millions of users. A relevant characteristic of the Moodle e-learning platform is its flexibility that allows the user to configure it in many ways.

This paper introduces a pilot study on the perception of the end user on the Moodle e-learning platform. The aim of this study is to identify which are the main factors that affect users perception on the platform quality (in terms of Usability, Functionality, Reliability, Efficiency and Quality in use). This article is structured as follows: after the research design, a brief literature review will describe the theoretical framework and the results of the pilot study will be introduced. A discussion of findings and a conclusion will follow.

2. Research design

Studies on Open Source Software have to deal with the difficulties in the selection of a random sample of users [8]. Usually the source code of Open Source software is freely distributed over the internet: this makes the real population of users unknown and impedes the possibility to create a truly random sample of users. Even if data available on Moodle website can be used as an estimation of the total size of Moodle end-users population, there is no certainty that they actually indicate the total users' population size. Therefore in this pilot study we decided to adopt an interpretive approach in order to try to understand how end users perceive the Open Source software. Our aim is not to predict or establish general law (as in a positivist study), but to comprehend the phenomenon from the point of view of the people involved in it, and to gain thorough understandings of it.

In our study the Moodle e-learning platform was used by a group of 80 students attending the "Computer mediated Training" course in a faculty of Education Science. These students used the platform for 6 months, both to download/upload contents and to create contents in training courses: as a matter of fact, they played, in two different points of time, the role of student and teacher in the Moodle platform.

We created a survey using the focus group technique (involving about the 10% of the final sample size) to define the most relevant aspects perceived by the users. The users' derived dimensions were confronted by those indicated in the ISO 9126 and ISO 25000 software quality model that we used as a reference. We decided to adopt these models to deepen the understanding of our case, mainly because they include not only the usability as a dimension, but others, interrelated, areas. We excluded from the dimension covered by the survey those that, we suppose, cannot be evaluated under the end user's perspective (ie: Maintainability and Portability). As a result the survey covers the following areas of the aforementioned standards: Functionality, Reliability, Usability, Efficiency and Quality in Use. In the survey we added another variable called Global Satisfaction as a control variable to explain the other dimensions. Before submitting it to the end users, the survey was tested with a separate sample of users to ensure that the text was clear enough.

3. Theoretical framework

The usability in the Open Source Software development has been scarcely considered until few years ago, probably due to the particular role that the user has in such a development environment. Open Source Software development has usually been based on the blurred distinction between users and developers. In traditional Open Source Software development process, the user can easily turn into a developer, contributing to the project by submit-ting a patch, writing a piece of code or doing other activities in support of the development. It can therefore be argued that the Open Source Software development process relies on the assumption that users and developers may converge. The diffusion of Open Source Software outside the development community contributes to sharpen the distinction between these two groups that are no longer equivalent. As a matter of fact they are nowadays too different [9]. In the traditional organization of an Open Source Software development process, users outside the community are hardly ever taken into consideration during the development. This call for major involvement of HCI expert inside Open Source Development projects, as the interface design might not be treated with the same openness that is used for the source code [9].

This set of circumstances has contributed to increase the interest of the research on Open Source adopting an end user perspective. As a consequence, the number of work on FLOSS usability is increasing (see for example [10, 11, 12, 13]). Recently large attention has been paid to flexibility, efficiency, robustness and effectiveness [10, 14]. Large part of available contributions try to provide suggestions to reduce the gap between the developers and the users outside the development community, trying to suggest methods to consider their needs in the development project. Studies on users' perception on Open Source Software are anyhow quite young.

Traditionally Open Source has been considered as a development process that could have a great chance to produce a successful piece of software due to the so called "Linus Law" [15] that synthesize the effect of the peer review process: "given enough eyeballs all bugs are shallow". This anecdotal assumption has been described by a predictive mathematical model [16] which states that OSS can converge to a bug free state even if average programmers quality is lower than the one employed in a traditional environment. Code inspection and statistical analysis of defect density have commonly been used to assess quality of Open Source projects [17, 18].

As a matter of fact, in a frequently cited IS success model [19, 20], DeLone and McLean contribute to highlight that between the software (system) quality and the benefits connected to its use, there is the user satisfaction. In an adapted version of DeLone and McLean IS success model (specific for Open Source) [21], Sang-Yong et al. identify that the user satisfaction is affected by software quality. Anyhow, recalling the possible differences among developers and users in the Open Source context, it is not granted that the software quality level is exactly the one that the user needs and, at the same time, it is not even granted that this is the only relevant dimension for him. The internal characteristics of the Open Source Software might therefore be of high quality, and respect high standards, but they might not be what the user wants or desire or, under a different point of view, the users might not be in the position to perceive and evaluate them. This consideration is, of course, still valid for the e-learning context, where the final user is defined in our case as the students who used the platform both as students and teachers.

4. Result of the study

In total we received 59 filled surveys. Data obtained from the surveys have been analyzed using descriptive statistics. We calculated the Cronbach's alpha as a reliability index for the results of the survey. The value for our survey is 0.84, which is high enough for an explorative study [22].

The user's profile emerging from the survey is as follows. Almost two third of the respondents (69%) have an age between 23 and 32 years, 61% use the computer for more than 7-9 years, and 57% have been using the Moodle platform at least 1-2 times a week. In general, the respondents do not have great experience with other Open Source Software because, on average, more than half of the respondents have never used other Open Source software before.

Variables	Obs	Mean	Std Dev	Var	Min	Max
Functionality	59	3.12	0.59	0.35	2	4
Reliability	59	2.92	0.82	0.66	1	4
Usability	59	3.33	0.71	0.50	1	4
Efficiency	59	3.25	0.68	0.46	2	4
Quality in Use	59	3.29	0.58	0.33	2	4
Satisfaction	59	3.41	0.53	0.28	2	4

Table 1. Descriptive statistic (1 min – 4 max)

The respondents profile has been analyzed using some descriptive statistics. The results are shown in table 1: the scores of these variables have been obtained by calculating the average score of each group of questions (in the survey) that were specifically referred to the variables indicated in table 1. These results show a good level of satisfaction of the respondents with Moodle, that is at the same time confirmed by the low level of the variance and of the standard deviation. Anyhow it has to be taken into consideration that the short Likert scale (from 1 to 4) tend to foster low variation.

Table 2 illustrate a correlation matrix among the five areas covered by the survey (Functionality, Reliability, Usability, Efficiency and Quality in Use) and the control variable called Global Satisfaction. The matrix shows positive correlation among the dimensions and significant values for the Functionality, the Usability and the Quality in Use areas.

	Funct.	Rel.	Usab.	Eff.	Qual.
Satisfaction	0.61	0.39	0.56	0.38	0.56

Table 2. Correlation matrix

Table 3 contains the linear regression model where the general satisfaction has been taken as an independent variable and has to be explained by the other six variables. The results of the regression model allow us to affirm that there is a predictive linkage only for three variables: Functionality, Usability and Quality in Use. Out of these three variables, the functionality is the one for which the linkage is the strongest. Reliability and Efficiency show a negative value.

The significance of the proposed linear regression model is partially validated by the F test study which is higher than 1 (13,50) and allow us to refuse the H0: $\beta=0$ hypothesis (the absence of a linear regression linkage among variables taken into consideration) and implicitly accept the H1: $\beta\neq0$ hypothesis (the existence of a linear regression linkage among variables). Furthermore, the Adj R-squared index shows that only 52% of the total variance can be explained by the linear regression model.

	Coeff.	t	P>|t|
Constant	0,820	2,46	0,017
Functionality	0,369	4,23	0,000
Reliability	- 0,120	-0,17	0,866
Usability	0,182	2,01	0,049
Efficiency	- 0,001	-0,01	0,989
Quality in use	0,248	2,21	0,031
Obs: 59	Adj R-Squared = 0,52	F Test = 13,50	

Table 3. Linear Regression

The p-value indicator (that gives us information on the validity of the null hypothesis) shows low probabilities for the Functionality (less than 1%), the Usability (around 5%) and the Quality in Use (around 3%). The p-value for Reliability can confirm the existence of a negative value while for the Efficiency we can hypothesize the total absence of relationships.

Further information can be obtained dividing the respondents into two groups. We adopted the division in two groups as a mean to identify which could be the impact on users' quality perception of the two following variables: the experience of users with the computer and the intensity of the usage of the platform.

The scores for the two groups of users formed distinguishing between beginners and advanced are indicated in table 4 and 5. The two groups were formed on the base of the total number of years of computer usage.

Variables	Obs	Mean	Std. Dev.	Var	Min	Max
Functionality	23	3,09	0,73	0,53	2	4
Reliability	23	2,95	0,71	0,50	2	4
Usability	23	3,39	0,58	0,34	2	4
Efficiency	23	3,21	0,67	0,45	2	4
Quality in Use	23	3,34	0,57	0,33	2	4
Satisfaction	23	3,39	0,58	0,34	2	4

Table 4. Beginner users perception

The scores indicate that, on average, advanced users are more satisfied than beginners in the use of the platform. The value of the standard deviation index confirms the homogeneity for the two samples.

Variables	Obs	Mean	Std. Dev.	Var	Min	Max
Functionality	36	3,14	0,59	0,35	2	4
Reliability	36	3,25	0,87	0,76	1	4
Usability	36	3,50	0,77	0,60	1	4
Efficiency	36	3,28	0,70	0,49	2	4
Quality in Use	36	3,44	0,61	0,36	2	4
Satisfaction	36	3,42	0,5	0,25	3	4

Table 5. Advanced users perception

Table 6 and table 7 indicates the correlation matrix between the global satisfaction and the other five variables taken into consideration in this study. The first table (6) shows that, for beginner users, the variables that are mostly linked to the global satisfaction are the Quality in Use, the Usability and, as a third option, the Functionality.

	Funct.	Rel.	Usab.	Eff.	Qual.
Satisfaction	0,56	0,26	0,60	0,24	0,66

Table 6. Beginners users correlation matrix

	Funct.	Rel.	Usab.	Eff.	Qual.
Satisfaction	0,67	0,47	0,55	0,47	0,50

Table 7. Advanced users correlation matrix

The correlation matrix for advanced users (Table 7), indicates instead that the most relevant variable affecting the global satisfaction is the Functionality and, on a second hand, the Usability. It has anyhow to be noticed that in this case, all the other variables (besides Functionality) have quite close values.

The second study made on this sample of users deals with the distinction between high and low usage intensity. These two groups of respondents were formed on the base of the frequency of use each user indicated in the survey. Students who indicated to have used the platform at list once or twice a week form the “Low” intensity group, while students that used the platform every day form the “High” intensity group.

Variables	Obs	Mean	Std. Dev.	Var	Min	Max
Functionality	14	3	0,68	0,46	2	4
Reliability	14	3	0,96	0,92	1	4
Usability	14	3,2	0,82	0,68	1	4
Efficiency	14	3,1	0,82	0,68	2	4
Quality in Use	14	3,2	0,58	0,33	2	4
Satisfaction	14	3,3	0,46	0,21	3	4

Table 8. Usage frequency: every day (High)

Table 8 indicates the score for users with a High intensity and table 9 the ones for users with Low intensity.

Variables	Obs	Mean	Std. Dev.	Var	Min	Max
Functionality	34	3,14	0,65	0,43	2	4
Reliability	34	3,21	0,84	0,71	1	4
Usability	34	3,5	0,66	0,43	1	4
Efficiency	34	3,2	0,64	0,41	2	4
Quality in Use	34	3,4	0,61	0,37	2	4
Satisfaction	34	3,4	0,5	0,25	3	4

Table 9. Usage frequency: 1-2 times a week (Low)

These two tables show that users who have a High usage intensity have a lower satisfaction in the platform usage. Table 10 contains the correlation matrix for these two groups of users. The correlation matrix indicates that, for users with a Low intensity of usage, the Functionality is the most relevant area, followed by the Usability and the Quality in Use. Users who have a High intensity of usage, instead, put much more emphasis on Quality in use, Efficiency and Functionality.

	Funct.	Rel.	Usab.	Eff.	Qual.
High	0.48	0,17	0,36	0,53	0,60
Low	0,62	0,49	0,55	0,37	0,52

Table 10. Correlation matrix on the base of usage intensity

Finally, the following tables (11 – 14) contain the regression models for the Beginners/Experts and Low intensity/High intensity groups of users.

Table 11 refers to the Beginners users and table 12 refers to the Advanced users. These two tables indicates that a weak link between the Global Satisfaction and the other areas exists. This link is able to explain, in both cases, the 52% (according to the Adf R-Squared index value) of the total variance. Between the two models, the one related to Experts is better ($F_{ex} = 8,44 > F_{bg} = 5,70$). For non expert users, the two factor that mainly explain the global satisfaction are Functionality and Quality in Use whereas, for expert users, Functionality is confirmed and Quality in Use is overtaken by Usability.

	Coef.	t	P>|t|
Constant	0,53	0,80	0,434
Functionality	0,36	2,37	0,030
Reliability	-0,43	-0,29	0,773
Usability	0,14	0,66	0,520
Efficiency	-0,09	-0,65	0,520
Quality in Use	0,51	2,35	0,031
Number of Obs: 23 Adj R-Squared = 0,52		Test F = 5,70	

Table 11. Regression model for beginners users

	Coef.	t	P>|t|
Constant	0,92	2,41	0,022
Functionality	0,40	3,47	0,002
Reliability	0,02	0,25	0,806
Usability	0,19	1,82	0,079
Efficiency	0,08	0,76	0,450
Quality in Use	0,05	0,39	0,700
Number of Obs: 36	Adj R-Squared = 0,52	Test F = 8,44	

Table 12. Regression model for advanced users

Table 13 refers to the regression model for users with a High usage intensity while table 14 refers to users with a Low usage intensity. Between the two models, the one for the Low intensity is better (according to the values of the Adj R-Squared and F indexes).

	Coef.	t	P>|t|
Constant	1,02	1,47	0,179
Functionality	0,22	1,43	0,191
Reliability	-0,11	-0,72	0,495
Usability	-0,05	-0,21	0,842
Efficiency	0,13	0,87	0,410
Quality in Use	0,52	1,37	0,209
Number of Obs: 14	Adj R-Squared =0,35	Test F = 2,46	

Table 13. Regression model for High usage intensity

	Coef.	t	P>|t|
Constant	1,00	2,31	0,029
Functionality	0,33	2,79	0,009
Reliability	0,88	0,93	0,360
Usability	0,23	2,07	0,047
Efficiency	-0,09	-0,73	0,471
Quality in Use	0,16	1,30	0,206
Number of Obs: 34	Adj R-Squared =0,50	Test F = 7,57	

Table 14. Regression model for Low usage intensity

This model indicates that for users with a low intensity of usage, the global satisfaction is mainly explained by Functionality and Usability. For users with a High intensity of usage the Functionality is the only variable (among all) that could be considered significant (according to the p-value). Anyhow, this model is able to explain only 35% of the total variance.

5. Discussion

Data collected from our survey allow us to formulate some consideration regarding users' perceived quality of the Moodle Open Source e-learning platform. On average, the platform performed very well, since scores were quite high for all the dimensions, the only one that has a lower score is the Reliability.

In our sample of respondents, the regression model allow us to state that, among all considered quality dimensions, Functionality, Quality in Use and Usability are the one that are linked to the Global Satisfaction of the end user. These three dimensions cover the following aspects. The Functionality concerns the features in the software that should satisfy stated or implied needs. The Usability is mainly concerned with the effort required by the software to the user in order to use its feature. Finally, Quality in Use, indicates the external quality perceived by the user while interacting with the software. According to the results of our survey the user is not interested in Reliability (which covers aspects like correctness or capability to maintain an agreed level of performance) and Efficiency (which indicates the relationship between the performance of the software and the amount of resources used to deliver it).

Investigating the impact of user's experience and usage intensity on the final quality perception we can formulate further considerations. For both groups (Beginners/Experts, High/Low usage intensity) the Functionality is a dimension that is always relevant. Adding to this dimensions there are others perceived relevant from respondents. For Beginners users the Global Satisfaction is mainly linked to the Quality in Use and Usability (functionality has to be added to these dimensions, as indicated in the previous paragraph). Advanced Users, instead, are more aware of platform Usability. Regarding these two groups of users it has to be noticed that, on average, advanced users' perception has registered a lower score compared to beginners'. Since the distinction between advanced and beginners has been made on the base of past experience of these two groups of users with the computer, we can argue that advanced users can either be under the effect of a *de facto* standard or do not find the features they desire in Moodle.

The second distinction regarding the usage intensity, allow us to state that, for low intensity use the quality perception is mainly explained by the Usability of the e-learning platform (besides Functionality). Under this point of view the user wants to find the features he needs (and expects to find) and wants them to be easy to use. When the usage intensity increase the Usability looses of importance and the Functionality is the only dimension that is able to explain users' quality perception of the Moodle e-learning platform in our sample.

6. Conclusions

Open Source software and its development processes are nowadays objects of interest for IS research. Past research on this topic have contributed to analyze that the Open Source development process can contribute to produce better software. Anyhow these judgements have always been based on an internal evaluation of software characteristics, on the base of the assumption that a high quality software could satisfy the needs of the users. Under this point of view Open Source software development counted, for long time, on the similarity between users and developers. With its diffusion, Open Source software has now reached users outside the development community and these users might have different needs than those expressed by traditional ones. There is no assurance, then, that Open Source software development processes can contribute

to a better output. Anyhow, on the base of this assumption Open Source based solutions spread in every environment, including e-learning.

In this research paper we introduced a pilot study on end user perceived quality on Moodle, a commonly used Open Source e-learning platform. We investigated the end user perception by means of a survey that has been submitted to a sample of 80 users (59 respondents) who have used the platform for 6 months. The end user perceptions were evaluated on the base of the following dimensions: Functionality, Reliability, Usability, Efficiency, Quality in Use and General Satisfaction. Our results indicate that, on average, users have a high satisfaction, but the areas that impact on perceived quality vary when the experience and the usage intensity vary. In particular:

- the Functionality is, among all the dimensions measured, the one that is always perceived as relevant;
- along with the Functionality, beginners users perceive the Quality in Use as relevant, while advanced users are more interested in its Usability;
- advanced users are, on average, less satisfied than beginners users with the Open Source Moodle e-learning platform;
- regarding usage intensity, intensive users are much more concerned with Functionality while seldom users pay more attention to the Usability.

The contribution of this research paper is mainly in two directions. First of all it shows the relevant dimensions affecting end users' perceived quality on the Moodle e-learning platform. Moreover it represent one of the first studies of end users' perceived quality on Open Source software. Anyhow, as a partial limitation to our findings, it has to be pointed out that the size of the sample (that is not so large) could have affected the results. Further research will be addressed to deepen the understanding gained in this research paper, trying to enlarge the sample of users investigated and to compare end users' perceived quality on Open Source e-learning platform with the one of commercial platforms.

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