

An Empirical Investigation into the Effect of Usability on Adoption of Desktop Open Source Software by University Students in Kenya

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Abstract

The adoption of Open Source products among expert users has been high over the years. Open Source Software (OSS) development tools and server applications have also been gaining popularity. There is however a significant lag in the uptake of desktop open source software especially by ordinary users in Africa. Usability issues have been raised as a major hindrance to the adoption of desktop OSS products. The objective of this paper is to present the results of OSS adoption levels by Kenyan university students and also to establish the effect of usability on adoption of Open Source desktop operating systems and applications by university students in Kenya. The empirical study revealed that in the absence of software piracy, OSS adoption is positively influenced by its usability.

Keywords: Open Source Software, adoption of software, software piracy, Technology Acceptance Model. Desktop applications, usability

1. Introduction

Several OSS products are generally regarded as being successful over the years with the Linux operating system (initially developed by Linus Torvalds in 1991) being on top of the list (Feller & Fitzgerald, 2000). Initially, researchers in the area of Information Systems believed that OSS would overtake proprietary software (PS) in adoption. However, this has not been the case especially in developing countries in Africa. Recent market share reports reveal that OSS products such as Linux and Firefox are lagging considerably behind in adoption (Applications Net, 2012).

One of the common hindrances given by many researchers is usability (Nichols & Twindale, 2003). Usability is an important attribute in software and has been defined as ‘the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use’ (ISO-9241-11, 1998).

It has been reported that most OSS developers develop the user interface for technical users who have the capability to change any features in the software they do not like (Levesque, 2004). Although OSS is distributed free of charge, one of the reasons why learning institutions are not switching to OSS is its usability and lack of wizards and tutorials (Hill & Gaughan, 2006). OSS developed for use by expert users has been widely adopted. In fact apache server has become the most widely used server product (Bretthauer, 2002). There is, however, a notable lag in OSS adoption compared to their proprietary counterparts in domains such as client operating systems and office productivity software which is a clear indicator that there may be significant barriers to OSS adoption among some sectors of the user population (Nagy, Yassin, & Bhattacharjee, 2010). Although, there is a general consensus among the majority of researchers that usability is one of the main hindrances to OSS adoption, as discussed by Sen (2007b) and Nichols and Twidale (2003), some studies conducted suggest that usability is not really the main issue (Huysmans, Ven, & Verelst, 2008). The study Huysmans et al. (2008), conducted concluded that, the main issue was migration of the data from PS to OSS especially in advanced and data intensive organizations.

The weaknesses of OSS such as usability problems have been seen by some researchers in a positive way. There are suggestions that it is an opportunity to improve the African continent's programming skills in the process of customization and improvement of the software to the local needs (Ghosh, 2003). The problem is that, most users do not want to take that direction, they prefer to use software that currently has the desired features.

Issues of patent and copyright laws have been cited by OSS developers as a major challenge and as the reason why they are not able to measure up to the standards of their PS counterparts in terms of usability (Iivari, Hedberg, & Kirves, 2008).

This paper will review OSS usability literature with the aim of establishing the role that usability plays in user acceptance of software. Known technology acceptance models will be reviewed, in order to establish the relationship between usability and acceptance of the technology. An empirical study will also be conducted to establish the impact of usability on acceptance of OSS desktop applications by students in Kenyan universities.

1.1 Objectives of the Study

The aim of this study was to achieve the following:

- 1) To investigate the level of adoption of desktop open source software by university students in Kenya
- 2) To investigate the effect of usability as a factor in the adoption of desktop open source software by university students in Kenya

1.2 Literature Review

Open source software has been in existence for some years now but issues of usability seem not to be ending any time soon. Although user centered designs are gaining popularity within OSS, usability is not being considered as one of their primary goals (Raza & Capretz, 2012). A comparison between PS and OSS reveals that one of the main competitive advantages of PS over OSS is usability and if OSS has to compete with PS, the OSS developers need to benchmark with PS software (Sen, 2007a).

Some researchers suggest that one way of solving the usability issue is by inclusion of usability testing methods in the context of OSS, by involving either users, or usability experts, or both in their projects (Sen, 2007b). In the recent past, a lot of research has been conducted on user involvement in the development process of OSS using the User Centered Design approach. User centered design is defined as the approach to 'interactive system development that focuses specifically on making systems usable' (ISO-13407, 1999). In our current world, including developing countries, computer users have been on the increase and it is therefore important to address usability issues in order to take care of these diverse sets of users (Shneiderman, 2000).

Software usability is defined in terms of understandability, learnability, operability and attractiveness (ISO/IEC-9126-1, 2001). Empirical results suggest that, improving the usability aspects such as understandability, learnability, operability, and attractiveness has a positive impact on the overall usability of OSS products (Raza, Capretz, & Ahmed, 2011).

Software piracy is a common phenomenon that makes PS easily available to personal computer (PC) users, either at a small cost or none at all. A recent study conducted by the Business Software Alliance (2010), shows that PS piracy is rampant and is on the increase in emerging economies such as Kenya. The study also noted that there are indications that piracy is proportional to the number of new PC acquisitions in these economies. The study revealed that piracy in the year 2010 was the second highest the organization has ever found, at a global rate of 42%. Software license reuse was found to be the most common form of piracy, although many perpetrators were not aware that it was illegal. The availability of pirated PS makes OSS look inferior to their PS counterparts (Knight, 2005). In his view there is a 'removal of social conscience in regards to copying' (p. 47), and users are not making a choice based on the traditional parameters of budget, suitability and effectiveness. He continues to argue that piracy removes the cost factor, leaving the biggest and best as the only viable choice.

A number of models exist that suggest different sets of technology acceptance determinants. The Unified Theory of Acceptance and Use of Technology (UTAUT) is one of the common theories of technology acceptance. The theory suggests a model that integrates elements across eight models (Venkatesh et al., 2003). The model suggests three direct determinants of intention to use which are; performance expectancy, effort expectancy and social influence. It also suggests two determinants of usage behavior which are intention and facilitating conditions. The moderating factors are experience, voluntariness, gender and age. The model is as shown in Figure 1.

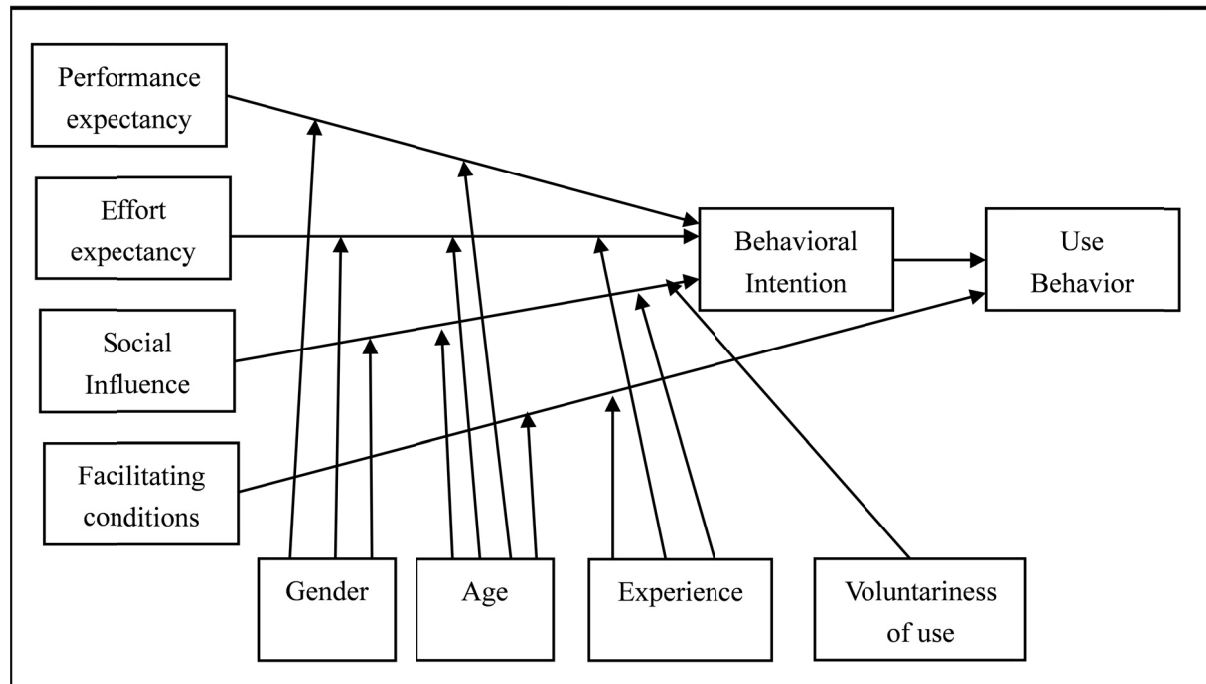


Figure 1. The Unified Theory of Acceptance and Use of Technology model

Source: (Venkatesh, Morris, Davis, & Davis, 2003)

A new modification of the UTAUT incorporates two factors, which are hedonic motivation such as enjoyment and price value of the technology and the amount of money to be spent against the perceived benefits of the technology (Venkatesh, Thong, & Xu, 2012).

The technology acceptance model (TAM) is another widely cited model, that seeks to explain the reasons why people accept or reject technology (Davis, 1989). In the theory, the author suggests that, when users are offered a new technology, a number of factors influence their choice about how and when they will use it, notably: Perceived usefulness (PU) – which is “the degree to which a person believes that using a particular system would enhance his or her job performance” (p. 320), and Perceived ease-of-use (PEOU) – which he defined as “the degree to which a person believes that using a particular system would be free from effort” (p. 320).

The model is shown in Figure 2.

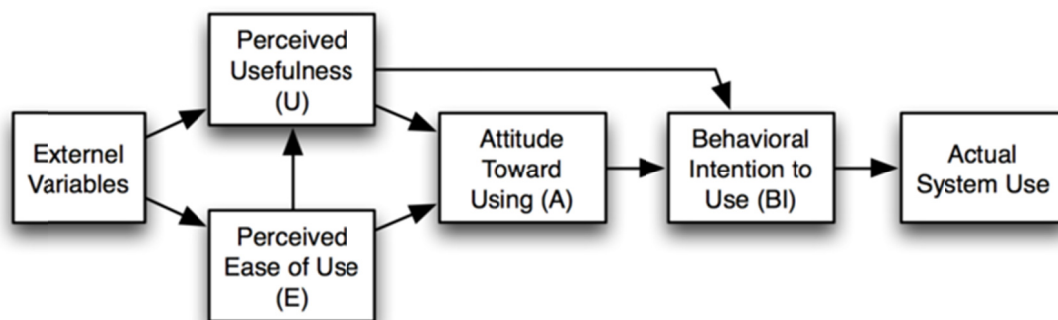


Figure 2. The Technology Acceptance model

Source: Davis (1989).

1.3 Hypothesis

In this study, usability will be taken as a dependent variable to adoption where the moderating variable will be PS piracy culture.

Thus the hypothesis;

H1 Usability of Open Source software has a positive correlation with its adoption

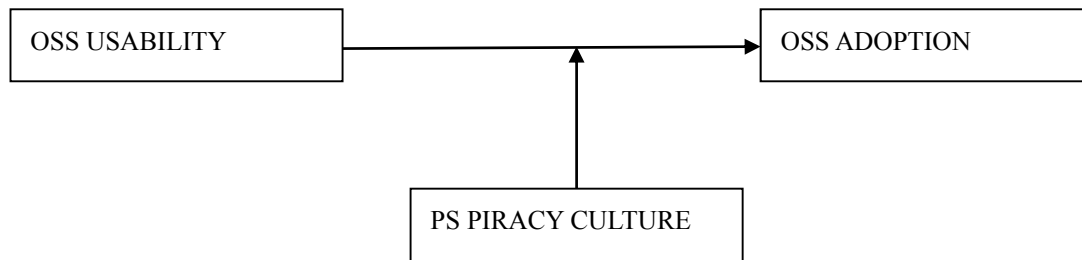


Figure 3. Model to be tested in this study

The literature suggests that, there are some more factors that affect adoption such as social influence, user training and performance expectancy, which have their moderating variables. This study will be restricted to usability as a factor, which determines OSS adoption with PS piracy culture as a moderating variable. The above restriction was made so that the results and the insights obtained from this study could become a point of reference for a larger study in the area.

2. Method

The research employed descriptive research design in achieving the objectives of the study. The research also used a quantitative methodology which is applied where the data collected contains some form of magnitude, usually expressed in numbers (Walliman, 2011). Descriptive research was used to establish the current adoption levels of OSS among Kenyan university students and to also establish if usability is a factor affecting the adoption of desktop OSS among Kenyan students. The key function of a descriptive research is to give description of the state of affairs as it exists currently (Kothari, 2004). The descriptive research design was found to be ideal for the research because the research would not control any of the variables, but would report on the current state of OSS adoption at the time of study and the factors affecting its adoption. The research design was also used to draw inferences about the possible relationships between variables identified by the researcher in the adoption of OSS.

2.1 Data Collection Tools

The collection of data was conducted through close ended questionnaires with a general structure of Likert scale questions with a pre-existing set of answers. A sample population of students in Kenyan universities was used as respondents. The method was used because the questionnaires were relatively easy to analyse, simple to administer, and information was collected in a standardized way.

2.2 Participant Characteristics

The 384 students who answered the questionnaire were in the 18-25 age bracket. The respondents either had personal computers at home or owned a laptop and their computer knowledge ranged from superior to the average.

2.3 Sampling Procedures

Purposive sampling was used to identify the sample. Purposive sampling is a form of non-probability sampling in which decisions regarding the individuals to be used in the sample are taken by the researcher, based upon a variety of criteria which may include specialist knowledge of the research issue (Sage, 2010). This method was used because it was important to identify students who own portable personal computers because they can make decisions about the kind of software to be installed in their computer.

Kenya had about 182,253 students in the year 2010/2011 and 16 universities (Kenya National Bureau of Statistics, 2011). Students from all the 16 universities were used in the study. A purposive random sample was selected in the chosen universities to identify a sample of students to be involved in the study. The population of

students in Kenyan universities is finite and the formula below was used to determine the sample size (Kothari, 2004).

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2 (N - 1) + z^2 \cdot p \cdot q}$$

Where:

p = sample proportion, q = 1 – p;

z = the value of the standard variate at a given confidence level and to be worked out from the table showing area under Normal curve;

N = size of population;

e = acceptable error (the precision);

n = sample size.

2.4 Sample Size

Based on the formulae above, the number of respondents used for the study was 384 students.

3. Research Findings

The research findings from the questionnaires are as shown on the tables below based on the results of the Likert scale questions. The questions were classified into three areas namely;

Usability, PS piracy culture, and lastly OSS adoption.

Table 1. Usability questions

	Usability questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Open source software such as Linux and Open Office is more user friendly than the proprietary software such as Microsoft office and Windows.	32.0	43.2	17.4	7.3	0.0
2	Open source software such as Linux and Open Office has familiar icons that are easily recognizable than the proprietary software such as Microsoft office and Windows.	21.6	46.4	17.4	14.6	0.0
3	Open source software such as Linux and Open Office has better help facilities, tutorials and wizards than the proprietary software such as Microsoft office and Windows.	26.0	35.7	14.3	24.0	0.0
4	I generally like the user interface of Open source software such as Linux and Open Office than the proprietary software such as Microsoft office and Windows.	20.8	35.9	17.4	14.6	11.2
5	Navigation while performing tasks in Open source software such as Linux and Open Office is easier than in the proprietary software such as Microsoft office and Windows.	28.9	39.3	24.5	7.3	0.0

The responses to the usability questions indicate that, a bigger percentage of respondents feel that PS is more user friendly than OSS and that PS has familiar icons that are easily recognizable while OSS does not. The respondents also felt that OSS does not have good help facilities, tutorials and wizards such as those offered by PS.

Majority of the users preferred the user interface of PS to that of the OSS. They also felt that navigation in OSS is more difficult than in PS.

Table 2. Proprietary software piracy culture

	Proprietary software piracy culture	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	All the proprietary software I have in my computer has a license that is not shared with other users	20.1	35.4	13.0	19.3	0.0
2	There is no need to purchase proprietary software such as Microsoft office and Windows from software stores such as PC world because I can easily get it from my friends.	12.2	10.4	24.2	25.0	28.1
3	I can spend large amounts of money to buy licensed proprietary software such as Microsoft Office 2010 which costs about 15,000 Kshs in my current financial status.	47.9	17.7	5.7	21.4	7.3
4	Proprietary software such as Microsoft office and Windows is too expensive for an ordinary student to afford	0.0	6.2	31.8	62.0	0.0
5	I get the same value from the unlicensed software with a computer owner who has licensed software	0.0	4.7	7.3	50.0	38.0

Responses to the above questions indicated that the majority of the computer users do not have a license for the PS they are using. The majority of the users also felt there was no need to buy PS because it is easily obtainable from friends. Most respondents who are students felt that they cannot afford the high cost of PS. This suggests the reason why they end up reusing licenses for this software.

A large number of respondents also agreed that the value obtained from the unlicensed software is the same as that of licensed software.

Table 3. OSS Adoption

	OSS Adoption	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	If your computer has windows operating system, would you be willing to replace it with either Linux or Ubuntu operating system?	26.0	27.6	33.1	13.3	0.0
2	If you bought a computer without an operating system, would you install a licensed copy of windows at 15,000 Kshs instead of installing a free Linux or Ubuntu operating system	39.8	18.5	24.0	4.7	13.0
3	I would recommend to a friend to install the free Linux or Ubuntu operating system instead of Windows operating system	4.9	46.6	28.9	19.5	0.0
4	The Windows I use was already pre-installed in the computer when I bought the computer	7.0	28.9	13.3	39.8	10.9
5	My computer only installed with Proprietary software such as windows and Ms Office has no Open source software such as Open office and Ubuntu	13.3	10.2	12.2	29.9	34.4

The responses to the questions reveal that OSS is not preferred by the majority of the computer users. The majority of respondents also indicated that they would not be willing to buy PS at a high cost. This shows that the cost of PS is prohibitive. There is also a clear indication that most of the computer owners who use PS, use PS which was pre-installed on their computers. It is also important to note that 246 students out of the 384 have only PS on their computers.

a) Correlation Analysis

The table below shows the results of a correlation test between OSS adoption and OSS usability in the absence of piracy culture.

Table 4. Correlation between OSS adoption and OSS usability in the absence of piracy culture

Correlations				
Control Variables			OSS ADOPTION	OSS USABILITY
PIRACY CULTURE	OSS ADOPTION	Correlation	1.000	.085
		Significance (1-tailed)	.	.049
		Df	0	381
	OSS USABILITY	Correlation	.085	1.000
		Significance (1-tailed)	.049	.
		Df	381	0

The results on Table 4 above show that, in the absence of piracy, OSS adoption is positively influenced by OSS usability.

The table below shows the results of a correlation test between OSS adoption and OSS usability in the presence of piracy culture.

Table 5. Correlation between OSS adoption and OSS usability in the presence of piracy culture

Correlations				
			OSS ADOPTION	OSS USABILITY
OSS ADOPTION	Pearson Correlation		1	.063
	Sig. (1-tailed)			.111
	N		384	384
OSS USABILITY	Pearson Correlation		.063	1
	Sig. (1-tailed)		.111	
	N		384	384

The results on Table 5 show that in the presence of piracy, OSS usability does not significantly affect OSS adoption.

b) Regression Model

A regression test was done in order to determine the statistical relationship between OSS usability and OSS adoption with OSS usability as the independent variable and OSS adoption as the dependent variable. The results are as detailed below;

$$1) Y = \beta_1 X_1 + e$$

Where

$Y = \text{OSS Adoption}$

$X_1 = \text{OSS Usability}$

$e = \text{error term}$

Variables	B	Significance	R2
Usability	1.27	0.00	0.765

The above results show that, usability has a positive effect on OSS adoption

The Goodness of fit = 76.5%

$$2) Y = \beta_1 X_1 + \beta_2 X_2 + e$$

Where

$X_2 = \text{piracy}$

Variables	B	Significance	R2
Usability	0.192	0.000	
Piracy	0.817	0.000	0.926

Goodness of fit = 92.6%

From the results above, there is a strong indication that piracy has a moderating effect on the relationship between OSS usability and its adoption.

4. Discussion

The research results strongly indicate that the adoption of OSS is very low among students in the Kenyan Universities. The percentage of users who have installed only proprietary products in their computers are 64.3%, which is quite high and is also in tandem with the adoption levels in other countries in Africa. This finding shows that the African countries are lagging behind the Non African emerging and developing economies countries such as China, India and Brazil in adopting OSS as reported by Reijswoud and Mulo (2007) and Laszlo (2007).

The findings in this study also strongly indicate that PS is too expensive for ordinary university students to afford with 93.8% indicating that the software is too expensive. The findings also indicate that most of the students do not buy PS, but they instead obtain it from their friends, which is license reuse. The piracy and license reuse trend is common in developing countries in Africa, and the Kenyan rates seem to be at the same level with other developing and emerging countries as reported by the Business Software Alliance (2010). A high percentage of users feel that OSS is not as usable as the PS and therefore, the users are hesitant to adopt the software because of difficulty in use.

The findings further reveal that in the absence of piracy, OSS adoption is positively influenced by OSS usability. This relationship is affected by PS piracy which has a moderating effect on the relationship between OSS usability and its adoption.

5. Conclusion

In this study we have investigated the effect of usability on adoption of desktop OSS in a Kenyan environment. The study was restricted to the university students in Kenya as computer users, and covered both public and private universities. The empirical results of this study strongly support the hypothesis that usability of Open Source software has a positive correlation with its adoption. The results also support that software piracy has a moderating effect on the relationship between OSS usability and its adoption.

The study conducted and reported here demonstrates that OSS developers need to think of ways of improving the usability of the software in order to achieve high adoption levels. The inclusion of easily recognizable icons, help facilities and wizards will come a long way in improving the software, and consequently the usability levels. The Kenyan government also has a role to play in stopping software piracy through awareness campaigns and by enforcing legislation that will discourage such illegal practices.

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