# Open Source E-learning Anxiety, Self-Efficacy and Acceptance – A Partial Least Square Approach

Norshidah Mohamed, Nor Shahriza Abdul Karim

**Abstract—** Open source electronic learning (e-learning) has given rise to a new way of learning for students. Implementation of open source e-learning provides quick benefits to educational administrators and educators but may present issues to students as users. Students may feel challenged to accept e-learning immediately as a new mode of learning, may experience computer application anxiety and may not have the confidence to use it quickly as desired. The paper reports the implementation of Claroline an open source e-learning at a public institution of higher learning in Malaysia. The research aims to establish among postgraduate business students (1) the acceptance of open source e-learning, that is, in terms of intention to use, perceived usefulness and perceived ease of use (2) the relationship between computer application anxiety and e-learning acceptance (3) the relationship between self-efficacy and e-learning acceptance. Students were encouraged to use the functions available in Claroline although not mandatory. A survey questionnaire was used as the instrument to collect data about e-learning acceptance. Partial least square was used for data analysis. There is evidence to suggest open source e-learning acceptance through significant relationships among students' perceived ease of use and intention to use. Contrary to past findings, there was no link between computer application anxiety and e-learning acceptance. There was, however, a positive and significant link between self-efficacy and intention to use. The implications of the research are discussed herein.

**Keywords—** Computer application anxiety, e-learning, open source software, self-efficacy.

## I. INTRODUCTION

THE Internet and rapid innovations in information technologies have given rise to advancements in business, learning and software development processes. In business, new business rules have been shaped in that people can do business transactions anytime and anywhere. Likewise in learning, people may use the Internet and mobile devices to learn anytime and anywhere. Besides, the Internet has seen developments in software development processes through open source software (OSS) that has emerged out of the contributions of geographically dispersed developers via the Internet

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Open source software has been regarded as "free software" means "free(dom) to modify the program's source code"; and not "at no cost [2]. Open source software is freely available and reusable [24].

Fuggetta [15] suggested that open source software continues to receive immense attention worldwide principally due to (1) the success of products such as Linux and Apache (2) the uneasiness about the Microsoft monopoly in the software industry and (3) the increasingly strong opinion that "classical" approaches to software development are failing to provide a satisfactory answer to the increasing demand for effective and reliable software application [15]. Further, the enthusiasm in open source software is perhaps largely attributable to research finding at the software system level that functionality, efficiency and sharing have significant influence on open source software utilization directly while portability, reliability and maintainability influence open source software utilization indirectly [31].

With OSS, implementation of a new system can be done in just a matter of a day; unlike decades ago where systems took years to be developed, deployed and commissioned. Open source learning management systems or e-learning present codes and application systems that can be easily downloaded, customized and configured. There is a variety of options for users to choose from when considering open source learning management system: Online Learning and Training (OLAT), OpenElms, Moodle, Sakai Project and Claroline are among popular brands. From educational policy makers' perspective, benefits of open source e-learning implementation include among others minimal spending on system development and implementation, facilitating ease in interactions between students and instructors, and reducing costs for paper-based materials. Veglis [33; 34] presents advantages and disadvantages of open source e-learning (Table 1). Table 2 shows the disadvantages of open source e-learning.

Table 1. Advantages of open source e-learning [34]

| Open Source Learning Management System Advantages |
| --- |
| • Asynchronous communication – is reflected through threaded discussions |
| • Synchronous communication – is enabled in the form of real-time chat |
| • Assessment tools – are provided for students to undertake tests and to receive feedback |
| • Collaborative work groups – functions to allow students to work in groups and instructors to give feedbacks for specific groups |
| • Content creation – allows instructors to post learning goals, course description and outline |
| • Messaging system – enables instructor to post announcements and communicate with students without face-to-face interaction |
| • Online file exchange – students may drop their assignments and instructors may collect them at a convenient time |
| • User tracking – instructors may track the frequency of students accessing the system |

Table 2. Disadvantages of open source learning management system [33]

| Open Source Learning Management System Disadvantages |
| --- |
| • Support of a variety of languages – this may limit to specific languages |
| • Installation and administration – this requires an experienced administrator and technical support |
| • Requirement of a designer – a skillful designer may be required to create a course |

Although open source e-learning present benefits to educators and educational policy makers, it may present challenges to students as users. In particular, students may not be ready for immediate adoption of open source software when they have been accustomed to paper-based lecture notes, thick folders and paper-based assignment submission. The research explores the relationship between computer application anxiety, self-efficacy and acceptance of open source e-learning.

Thus, the research questions are formulated accordingly: (1) *Is there a relationship among perceived usefulness, perceived ease of use and intention to use open source e-learning?* (2) *Do computer application anxiety and self-efficacy relate to e-learning acceptance?*

The research aims to determine the relationship among perceived usefulness, perceived ease of use and intention to use open source e-learning using partial least square approach. Besides, the research investigates computer application anxiety, self-efficacy and e-learning acceptance.

## II. LITERATURE REVIEW AND HYPOTHESES

This section discusses the theoretical foundations for the research. Drawing on literature on computer anxiety, social cognitive theory and technology acceptance model (TAM), we seek to establish and test a theoretical model.

The notion of predicting behavior from intention is well established in the Theory of Reasoned Action (TRA) [1; 14]. Using the TRA, Davis [10] developed the Technology Acceptance Model (TAM) and later Davis et al. [11] extended it (Fig. 1) with the inclusion of external variables as independent variable and behavioral intention as dependent variable.
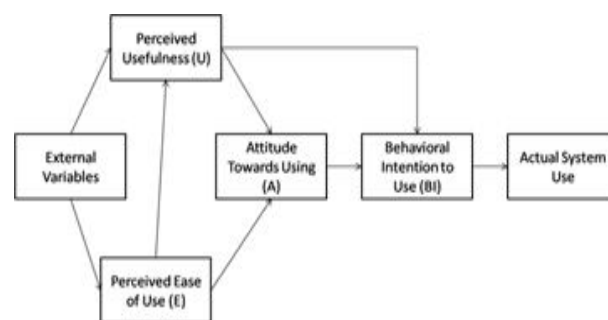


Fig. 2 Technology Acceptance Model [10]

The TAM postulates perceived usefulness and perceived ease of use as two theoretical constructs that determine system use [10]. Davis [10] conceived "perceived usefulness as the degree to which a person believes that using a particular system would enhance his or her job performance". Perceived ease of use is "the degree to which a person believes that using a particular system would be free of effort" [10]. TAM posits that perceived ease of use and perceived usefulness are causally linked to attitudes, intentions and actual use (behavior) [10]. Davis [10] suggested that external variables such as system features documentation and training affect perceived usefulness and perceived ease of use.

In the last two decades, research sees the enthusiasm in investigating TAM [25; 30]. Among Indonesian users of Moodle, Hussein et al. [21] found that while perceived ease of use related to perceived usefulness and intention to use, there is no link for the relationship between perceived usefulness and intention to use. In Taiwan, Chuo et al. [8] found significant relationships between (1) perceived usefulness and intention to use (2) perceived ease of use and intention to use (3) perceived ease of use and perceived usefulness. This is consistent in Hasan and Ahmed [18] who conducted a study on undergraduate business students using statistical analysis in Excel application. In a meta-analysis of 88 studies, King and He [25] found significant relationship between perceived usefulness and intention to use. The relationship between

perceived ease of use and intention to use was for internet applications. Therefore, it is hypothesized that:

**H1a:** Perceived usefulness is significantly and positively related to intention to use open source e-learning.

**H1b:** Perceived ease of use is significantly and positively related to intention to use open source e-learning.

**H1c:** Perceived ease of use is significantly and positively related perceived usefulness open source e-learning.

The notion of computer anxiety arises out of the fast development of technology coupled with individuals' phobia of dealing with computers [18]. Chua et al. [7] characterized computer anxiety as the fear of using the computer or fear of the possibility of using a computer. Barbeite and Weiss [5] refer computer anxiety as affective response. Computer anxiety is not similar to negative attitudes toward computer in that negative attitudes are characterized as beliefs and attitudes while computer anxiety is marked by response toward using computers [19]. The causes of computer anxiety are varied. Doronina [12] reported such anxiety arose out of among others, fear of causing damage to computers and of making mistakes while using computers and of technology or math. Prior researches demonstrate that individuals with background in Science or Engineering have less computer anxiety than those in humanities background [28]. In a recent study on business students, Broome and Havelka [6] found a significant difference in computer anxiety amongst different academic majors, students who have previously taken different number of computer courses and students who have previously learned programming languages.

Accordingly, individuals with computer anxiety have negative attitudes towards computers, low motivation and low performance [19]. Prior researches found significant and negative relationship between computer anxiety and computer attitude [22]; between computer anxiety and perceived ease of use [35]; between computer anxiety and intention to use a system [23]; Chuo et al. [8] in a research of e-learning systems implementation among executives at six teaching hospitals in Taiwan found that computer anxiety was negatively correlated to perceived ease of use and perceived usefulness. Hasan and Ahmed [16] found application anxiety correlated to perceived ease of use. Wang and Lin [36] found significant and negative relationship between computer anxiety and intention to use massive multiplayer online game.

The social cognitive theory [4] subscribes to the notion that "persons are neither autonomous agents nor simply mechanical conveyers of animating environmental influences." The theory suggests that people contribute to their motivations and actions. As an example, while environmental factors can influence individuals' unhealthy behavior, individuals, however, may exhibit self-control skills to decide on such behavior. Accordingly, individuals may be exposed to self-generated influences. Self-efficacy is an underlying key construct in social cognitive theory [4] that defines human motivations, affect and actions. Self-efficacy is suggested as affecting individuals' thought patterns which may be either self-aiding or self-hindering [4]. Self-efficacy has been

identified as individuals' beliefs about the ability to perform a specific behavior [9]. Accordingly, self-efficacy has been found to correlate to perceived ease of use and perceived usefulness [18]. In investigating citizens' continuance to use e-government Website, Wangpipatwong et al. [39] found that computer self-efficacy correlate to perceived usefulness and continuance intention but not to perceived ease of use. Lee et al. [27] found that self-efficacy is correlated to Web-usage intention. Hussein et al. [21] found positive and significant relationship between self-efficacy and perceived usefulness in using Moodle in Indonesia. They did not find relationship between self-efficacy and perceived ease of use. With research context in massive multiplayer online game, Wang et al. [38] found significant and positive relationships between (1) self-efficacy and intention to use (2) self-efficacy and perceived playfulness. However, Wang et al. [37] did not find self-efficacy and perceived enjoyment although Wang and Lin [36] initially hypothesized a relationship.

Based on TAM, we construct external variables as computer application anxiety and self-efficacy. Thus, we hypothesize:

**H2a:** Computer application anxiety is significantly and negatively related to perceived usefulness of open source e-learning.

**H2b:** Computer application anxiety is significantly and negatively related to perceived ease of use of open source e-learning.

**H2c:** Computer application anxiety is significantly and negatively related to intention to use open source e-learning.

**H3a:** Self efficacy is significantly and positively related to perceived usefulness of open source e-learning.

**H3b:** Self efficacy is significantly and positively related to perceived ease of use of open source e-learning.

**H3c:** Self efficacy is significantly and positively related to intention to use open source e-learning.
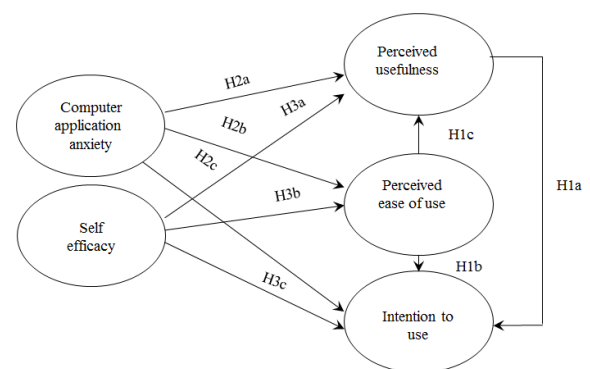
Fig. 2 shows the present research theoretical model.



Fig. 2 Theoretical Model

## III. RESEARCH DESIGN

### A. Research Context

The research was conducted with postgraduate business students as research participants at a public institution of higher learning in Malaysia. The students are mostly working

professionals. A survey questionnaire was used as the instrument. Claroline (http://www.claroline.net) an open source learning management system was chosen for implementation.

Claroline was developed using the PHP/MySQL. The University of Louvain (Belgium) initially started it. Thereafter, it was released under Open Source license (GPL). Presently, a community of users and developers worldwide support Claroline. This renders its presence in over 100 countries worldwide. In the present study, it was envisioned that Claroline would enable instructor-students ease in interaction and knowledge sharing through forums during weekdays when classes were not in session. Further, students were encouraged to participate in assessment through Claroline. The Claroline implementation is expected to ultimately complement face-to-face interaction between instructors and students.

For the purpose of achieving quick wins, only document repository, calendar, messaging, forum, exercises and assignments functions were enabled. Instructors are able to post feedback and assignment scores for their students to view. Students of the course were encouraged to use the functions available in Claroline although not mandatory. No penalty was given for students who did not access the Claroline. Instructors were given a brief of Claroline prior to implementation.

### B. Population and sampling

The estimated population for the research is 400. The sample reported in this study is drawn from active postgraduate part-time business students. Classes for the courses were held during weekend. Most students for the course are working professionals during the weekday. There were 160 students in the sample.

### C. Measures

Table 3 shows the sources for the measures of the constructs used in the research. Students were asked to evaluate the Claroline using a survey instrument. The instrument uses a five-point Likert scale for computer application anxiety, self-efficacy, perceived usefulness, perceived ease of use and intention to use measures where 1 refers to strongly disagree and 5 refers to strongly agree.

Table 3. Constructs and Measures

| Constructs | Sources |
| --- | --- |
| Intention to use | [1; 14] |
| Perceived usefulness | [10] |
| Perceived ease of use | [10] |
| Self-efficacy | [9] |
| Computer anxiety | [19] |

### D. Data analysis

Descriptive analysis and the reliability analysis for pilot test were made using SPSS version 16. Path analysis approach was adopted for the research using SmartPLS (http://www.smartpls.de).

## IV. RESULTS

### A. Pilot test

Table 4 shows the breakdown of students by gender and age groups for the pilot test. These variables use nominal and categorical type of data respectively. The analysis is reported in frequency and percentage form.

Table 4. Profile of respondents for pilot test

| Profile of Respondents | | Frequency | % |
| --- | --- | --- | --- |
| Gender | Male | 19 | 45.2 |
| | Female | 22 | 52.4 |
| | Missing | 1 | 2.4 |
| | Total | 42 | |
| Age | 20-29 | 15 | 35.7 |
| | 30-39 | 16 | 38.1 |
| | 40-49 | 9 | 21.4 |
| | Above 50 | 1 | 2.4 |
| | Missing | 1 | 2.4 |
| | Total | 42 | |

The majority of respondents were female (52.4%). In terms of age group, those in the 30-39 age range were the majority. Those in the 20-29 age range account for the next 35.7% of the sample. Generally, the pilot test sample is made up of younger age group of students. The fewest number of respondents were above 50 years old.

Table 5 shows the reliability analysis of the measures for pilot test.

Table 5. Pilot test reliability analysis

| Constructs | No. of Items | Cronbach's alpha (α) ) |
| --- | --- | --- |
| Intention to use | 4 | 0.854 |
| Perceived usefulness | 4 | 0.811 |
| Perceived ease of use | 6 | 0.881 |
| Self-efficacy | 5 | 0.848 |
| Computer anxiety | 4 | 0.884 |

Reliability analysis is the procedure used to ascertain the internal consistency of the measures. According to Hair et al. [17], Cronbach's alpha above 0.6 for exploratory study is considered reliable. In the research, the range of Cronbach's alpha is between 0.811 and 0.884.; thus all measures in the study are reliable.

Following internal consistency achieved from the pilot test, the researchers proceeded with data collection. The subsequent sections describe the analysis on the sample.

### B. Descriptive profile of sample

Table 6 shows the breakdown of students by gender and age groups. These variables use nominal and categorical type of data respectively. The analysis is reported in frequency and percentage form.

Table 6. Profile of respondents for sample

| Profile of Respondents | | Frequency | % |
|---|---|---|---|
| Gender | Male | 78 | 48.8 |
| | Female | 81 | 50.6 |
| | Missing | 1 | 0.6 |
| | Total | 160 | |
| Age | 20-29 | 87 | 54.4 |
| | 30-39 | 55 | 34.4 |
| | 40-49 | 15 | 9.4 |
| | Above 50 | 2 | 1.3 |
| | Missing | 1 | 0.6 |
| | Total | 160 | |

The majority of respondents were female (50.6%). In terms of age group, those in the 20-29 age range were the majority 54.4%). Those in the 30-39 age range account for the next 34.4% of the sample. Generally, the sample is made up of younger age group of students. The fewest number of respondents were in the above 50 age range. The mean number of working years spent was reported 7.9 years with the maximum reported as 28 years. The mean number of working years spent on the present job was reported 4.9 years with the maximum reported as 20 years.

Table 7 shows the profile of Likert-scale measures. Generally the mean values for intention to use, perceived usefulness, perceived ease of use and self-efficacy measures and average scores are well above 3. This indicates that the majority evaluate in agreement to the statements. On the other hand, all the measures for computer application anxiety and the average score were below 3. This suggests that the majority of students do not agree that they experience anxiety with the open source e-learning.

Table 7. Profile of Likert-scale Measurees

| | Mean |
|---|---|
| **Intention to use** | |
| 1. It is worth to use the *Claroline*. (ITU1) | 3.65 |
| 2. I will frequently use the *Claroline*. in the future. (ITU2) | 3.77 |
| 3. I will strongly recommend others to use the Claroline. (ITU3) | 3.69 |
| 4. I plan to use the *Claroline*. (ITU4) | 3.83 |
| Average intention to use score: | 3.73 |
| **Perceived usefulness** | |
| 1. Using the *Claroline* improves my learning performance. (PU1) | 3.61 |
| 2. Using the *Claroline* enhances my effectiveness in learning. (PU2) | 3.58 |
| 3. Using the *Claroline* improves the quality of learning. (PU3) | 3.59 |
| 4. Overall, I find using the *Claroline* useful in learning. (PU4) | 3.69 |
| Average perceived usefulness score: | 3.62 |
| **Perceived ease of use** | |
| 1. Using the *Claroline* in learning is easy for me. (PEOU1) | 3.73 |
| 2. I find it easy to get the *Claroline* to do what I want to do. (PEOU2) | 3.46 |
| 3. Getting information from the *Claroline* is easy. (PEOU3) | 3.72 |

| | |
|---|---|
| 4. My interaction with the *Claroline* is clear and understandable. (PEOU4) | 3.55 |
| 5. It would be easy for me to become skillful at using the *Claroline*. (PEOU5) | 3.58 |
| 6. Overall, I find the *Claroline* easy to use. (PEOU6) | 3.75 |
| Average perceived ease of use score: | 3.63 |
| **Self-efficacy** | |
| 1. I would be able to use the *Claroline* if there is no one around to show me how to use it. (SE1) | 3.62 |
| 2. I would feel comfortable using the *Claroline* on my own. (SE2) | 3.71 |
| 3. I feel confident to download and save files from the *Claroline* when needed. (SE3) | 3.84 |
| 4. I feel confident to post and reply to messages in a forum in the *Claroline*. (SE4) | 3.35 |
| 5. I feel confident understanding the links in the *Claroline*. (SE5) | 3.53 |
| Average self-efficacy score: | 3.61 |
| **Computer application anxiety** | |
| 1. I feel nervous about using the *Claroline*. (CA1) | 2.35 |
| 2. It scares me to think that I could lose a lot of information using the *Claroline* by clicking the wrong button. (CA2) | 2.43 |
| 3. I hesitate to use the *Claroline* to post and reply to messages for fear of making mistakes I cannot correct. (CA3) | 2.60 |
| 4. The *Claroline* worries me. (CA4) | 2.28 |
| Average computer anxiety score: | 2.41 |

### C.   Partial Least Square Findings

Partial least square technique was applied to detect relationships among constructs. Convergent validity is achieved if loadings of the measures to their respective constructs are at least 0.60 [3; 26]. Table 8 shows the range of loadings is between 0.690 and 0.9 thus establishing convergent validity. The composite reliability (CR) of all constructs were above 0.6 [3] and average variance extracted (AVE) were above 0.5 [13] thus further supporting convergent validity

The inter-variable correlations (Table 9) were examined and the square-root AVE were higher than correlations suggesting that the construct was more closely related to its own measures thus supporting discriminant validity [13].

Table 8. Loading, CR and  AVE

| Construct | Item | Loading | CR | AVE |
|---|---|---|---|---|
| Intention to use | ITU1 | 0.767 | 0.915 | 0.729 |
| | ITU2 | 0.900 | | |
| | ITU3 | 0.884 | | |
| | ITU4 | 0.857 | | |
| Perceived usefulness | PU1 | 0.894 | 0.930 | 0.768 |
| | PU2 | 0.884 | | |
| | PU3 | 0.877 | | |
| | PU4 | 0.851 | | |
| Perceived ease of use | PEOU1 | 0.690 | 0.901 | 0.602 |
| | PEOU2 | 0.765 | | |
| | PEOU3 | 0.803 | | |
| | PEOU4 | 0.784 | | |

| | | | | |
|---|---|---|---|---|
| | PEOU5 | 0.766 | | |
| | PEOU6 | 0.840 | | |
| Self-efficacy | SE1 | 0.724 | 0.897 | 0.635 |
| | SE2 | 0.840 | | |
| | SE3 | 0.796 | | |
| | SE4 | 0.767 | | |
| | SE5 | 0.853 | | |
| Computer application anxiety | CA1 | 0.889 | 0.932 | 0.774 |
| | CA2 | 0.881 | | |
| | CA3 | 0.825 | | |
| | CA4 | 0.921 | | |

Table 9. Inter-variable correlations

| | ITU | PU | PEOU | SE | CA |
|---|---|---|---|---|---|
| ITU | **0.854** | | | | |
| PU | 0.451 | **0.876** | | | |
| PEOU | 0.500 | 0.551 | **0.776** | | |
| SE | 0.403 | 0.292 | 0.691 | **0.797** | |
| CA | -0.218 | -0.005 | -0.283 | -0.433 | **0.88** |

Fig.3 shows the theoretical model path results. The values stated on the path are path coefficients and t-value (in bracket).

30.4% of the variance in intention to use can be explained by self-efficacy and perceived ease of use. 32.4% of the variance in perceived usefulness can be explained by perceived ease of use. Out of the original nine hypothesized relationships, only three show significant relationships:

- *between self-efficacy and intention to use* – The evidence suggests that students who believed they had the ability to operate the e-learning intend to use it in future. This supports [39].
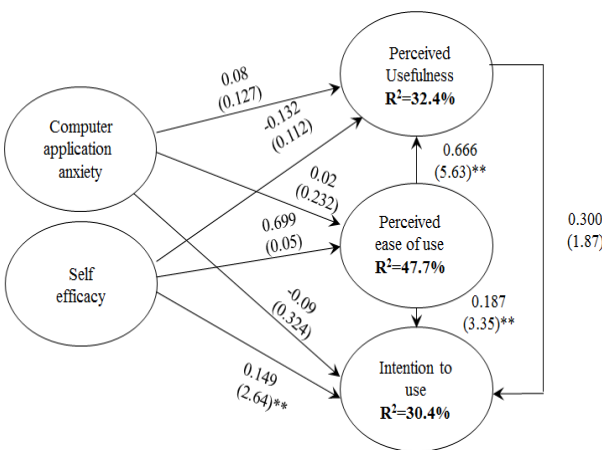


Fig. 3 Path Results

- *between perceived ease of use and intention to use* – The evidence suggests that students who perceived the e-learning is easy to operate would in turn intend to use it in future.

This is consistent with Hussein et al. [21]; Chuo et al. [8] and Hasan and Ahmed [18].

- *between perceived ease of use and perceived usefulness* – Students who perceived the e-learning is easy to operate would find it useful and thus would in turn intend to use it in future. There is however no direct link between perceived usefulness and intention to use. The result for the relationship between perceived ease of use and perceived usefulness supports Hussein et al. [21], Hasan and Ahmed [18] and Chuo et al. [8].

Surprisingly there is no significant relationship between computer application anxiety and all e-learning acceptance variables. The advancement of technologies and its proliferation into society have seen many new application systems introduced at a rapid pace significantly. Open source software is an example of such application. In the information age, users are exposed to varied application systems and technological devices. The sample consists of a majority of students who are working professionals and are below 39 years old. Further, the university's environment hinges on science and technology. The evidence suggests a possibility of the background of the sample in terms of age, prior educational background, occupation and university's environment accounting for insignificant relationship between computer anxiety and open source e-learning acceptance. This may be supported by prior recent studies in [6; 28]. Table 10 shows the summary of hypotheses.

Table 10. Summary of Hypotheses Results

| Hypotheses | Findings |
|---|---|
| **H1a:** Perceived usefulness is significantly and positively related to intention to use open source e-learning. | Not supported |
| **H1b:** Perceived ease of use is significantly and positively related to intention to use open source e-learning. | Supported |
| **H1c:** Perceived ease of use is significantly and positively related perceived usefulness open source e-learning. | Supported |
| **H2a:** Computer application anxiety is significantly and negatively related to perceived usefulness of open source e-learning. | Not supported |
| **H2b:** Computer application anxiety is significantly and negatively related to perceived ease of use of open source e-learning. | Not supported |
| **H2c:** Computer application anxiety is significantly and negatively related to intention to use open source e-learning. | Not supported |
| **H3a:** Self efficacy is significantly and positively correlated to perceived usefulness of open source e-learning. | Not supported |
| **H3b:** Self efficacy is significantly and positively related to perceived ease of use of open source e-learning. | Not supported |
| **H3c:** Self efficacy is significantly and positively related to intention to use open source e-learning. | Supported |

## V.    CONCLUSION

We began with the research questions: (1) ***Is there a relationship among perceived usefulness, perceived ease of use and intention to use open source e-learning? (2) Do computer application anxiety and self-efficacy relate to e-learning acceptance?*** We build on computer anxiety, social cognitive theory and TAM as a basis to answer the research questions. The context of the research is open source e-learning among postgraduates in a Malaysian higher educational institution.

Surprisingly and contrary to past findings, there is evidence to suggest that computer application anxiety is not a factor for open source e-learning acceptance in students' learning environment. The rapid advancement of technologies and students' technical background may have accounted for students' ease in adapting to e-learning. Thus computer application anxiety is no longer a factor that links to e-learning acceptance. This is further complemented with university's environment that emphasizes on Science and Technology.

Consistent with many past findings, there is evidence to suggest self-efficacy plays a role in intention to use. This further re-affirms that when individuals believed they have the ability to operate a technology, they would in turn be favorable to use the new technology.

The research presents limitations that should be acknowledged. The research used a cross-sectional survey research approach. Further, only students of a particular program participated in the research. Thus, the findings may not be generalized in the context of the entire institution and thus may have to be carefully interpreted.

Future research may consider longitudinal approach. It will be interesting to further explore the effects of students' prior academic background and occupation on the relationships between computer application anxiety and e-learning acceptance. Other areas for future investigation may cover a sample of postgraduates in other institutions as research participants.

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