Implementing Open Source Platform for Education Quality Enhancement in Primary Education: Indonesia Experience

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ABSTRACT
Information and Communication Technology (ICT)-supported learning using free and open source platform draws little attention as open source initiatives were focused in secondary or tertiary educations. This study investigates possibilities of ICT-supported learning using open source platform for primary educations. The data of this study is taken from a 3-years ICT-supported education quality enhancement project involving 300 elementary schools and 200 junior high schools in the Special Province of Yogyakarta, Indonesia. In this research, 50 elementary and 50 junior high schools are used as samples for pilot observation. Technology Acceptance Model and Structural Equation Model are employed to analyze the findings. It is concluded that open source platform is accepted even in a low e-readiness environment such as in primary educations. Further, this research also develops strategies to successfully implement open source platform for ICT-supported learning in primary educations. However real e-learning outcome is not yet measured as this study is performed before the national exam of the participating students performed.

INTRODUCTION
Information and communication technology (ICT) is expected to produce positive effects in education not only because ICT can improve communications among relevant education stakeholders, such as students, school managers, teachers, and government staff responsible of education, but it can also increase motivation to study. It is believed that ICT will contribute in supporting teaching and learning process, enhance school governance by improving accessibility to useful Web sites, enhancing ICT skills, and improving interactions among schools and teachers. ICT is also often perceived as a catalyst for change; change in teaching style, change in learning approaches and change to access to education information (Hoskins & van Hooff, 2005), (Lee, Tseng, et al, 2007).

Funded by the Japan International Cooperation Agency (JICA), the Ministry of Communication and Information of the Republic of Indonesia together with the Government of Special Province Yogyakarta has initiated an information and communication technology utilization program for educational quality enhancement in Yogyakarta Province. The project involved selected 300 elementary schools and 200 junior high schools in the Special Province of Yogyakarta, Indonesia. This project is used as a model of ICT-based education quality enhancement implementation in Indonesia and expected to be replicated to other provinces in order to level up the quality of education.

The expected outcome of the project is to enhance the quality of primary educations in Yogyakarta Province especially in mathematics and science. The outcome will be observed through increase in the average score in National Exams, increase in Mathematics and Science Olympiad participation, increase in teachers' ICT competence in general ICT skills as well as in the utilization of ICT for teaching-learning process.

The study is important for three reasons. First, this is the first large scale ICT-supported learning project implemented in primary educations in Indonesia. Most of e-learning implementation project in developing countries focus on higher level educations such as secondary schools (Year 10 to Year 12) or even tertiary education or university level (Anonymous, 2008). The result of this study can be used further to formulate better strategy in implementing e-learning in primary educations in other provinces or countries. Secondly, the project is implemented using open source platform. OpenSUSE, a Linux distribution was chosen by the project to minimize project cost as well as an initiative to introduce open source at early age students. Even though National Education ICT Curriculum is based on Microsoft platform, the decision of using open source in developing countries struggling with copyright problems like Indonesia is deliberately taken as free and open source platform has many beneficial advantages (Orman, 2007). The third reason is that Yogyakarta Province, a relatively small and rural province, was chosen as the pilot province for the project. The project can be seen as a

"model" for and open source based e-learning implementation in primary education in Indonesia as Yogyakarta Province can be considered representing average of Indonesian provinces. The scientific importance of this study is to investigate factors that determine e-learning readiness and e-learning implementation success.

However, due to that the project finished by end of 2012, the expected real outcome is not yet available to be measured. Kickul & Kickul (2006) described that e-learning outcomes are determined primarily by attitude towards e-learning. Therefore this study uses behavioral intent to use as a proxy to the e-learning outcomes. The limitation of this study is assuming that behavioral intent to use as approximation to the e-learning outcome. Further observation is undergone to investigate the real outcome of the project after one full cycle of study of the participating students from their National Exams results.

IMPLEMENTING ICT-ASSISTED LEARNING FOR EDUCATION QUALITY ENHANCEMENT

While most application of ICT were in the area of improving business competitiveness in business sectors, the application of ICT to improve quality of education has drawn attentions to researchers in the last decade. ICT is expected to generate breakthrough in education as what it did in the area of business. Various efforts in integrating ICT into educational settings to support teaching learning have been initiated since the 1980s (Starr & Milheim, 1996).

Research has shown that e-learning outcomes are influenced by a complexity of factors. Kickul & Kickul (2006) found that students' attitude towards e-learning, such as proactive personality and learning goal orientation, is an important determinant of e-learning outcomes. Beyond students' attitude, other researchers have shown that various factors such as learning strategy (Santhanam, Sasidharan, & Webster, 2008), technology acceptance, and system quality (Chang & Tung, 2008), effective or appropriate e-learning environment (Gregg, 2007; Wangpipatwong & Papasratorn, 2007), and also learning motivation (Meissonier, Houzé, Benbya, & Belbaly, 2006) have significant contribution to the e-learning outcome.

An observation by Ho (2009) with focus on analysis of e-learning system quality, technology readiness, online behavior, and learning outcome of students in urban junior high schools, concluded that the qualityof the e-learning systems and the technology readiness supported by appropriate leadership behavior play a significant impact on the e-learning outcome.

MEASURINGE E-LEARNING READINESS IN THE SAMPLE SCHOOLS

As measuring readiness is important before implementing e-learning systems especially in schools that have little access to computers. Chapnick (2000) developed a model to measure e-learning readiness. She categorized readiness into 8 factors. The first factor is psychological readiness. This factor includes students and teachers attitudes toward e-learning initiative. This factor is considered one of the most important factors as it impacts directly the e-learning implementation process. The second is sociological readiness. This factor considers the interpersonal and cultural aspects of the e-learning environment. Learning preference of the students and teaching preference as well as existing learning culture may impacts e-learning outcome significantly. The third is environmental readiness. This factor considers education stakeholders support, education policy, and leadership's attitude toward e-learning. The fourth factor is human resource readiness. This factor considers the availability of human resources to support e-learning infrastructure and develop e-learning content. The fifth factor is financial readiness. This factor considers the availability of budget to support e-learning implementation and operation. The sixth factor is technological skill (aptitude) readiness. This factor considers observable and measurable technical competencies of the content developers, technical support staffs, and teachers' ICT competencies. The seventh factor is equipment readiness. This factor considers the availability of e-learning ICT infrastructure which includes workstations, screen projectors, network connection, and other relevant proper equipment possession. And the last factor is content readiness. This factor considers the e-learning material for relevant subject matters and suitability with applicable subject curriculum.

In this observation, 50 elementary schools and 50 junior high schools are selected as sample schools. Each sample elementary school is represented by its mathematics teachers in Year 4, Year 5, and Year 6 as the e-learning is only employed for Mathematics, while sample junior high school is represented by its mathematics teachers and science teachers in Year 7, Year 8, and Year 9 as in these years e-learning is applied for Mathematics and Science. The total number of respondents is 600 teachers. Most of the teachers were not exposed to open source before as the National Education ICT Curriculum is based on Microsoft Windows platform and the teachers are familiar with that proprietary platform. The sample schools are evenly distributed to all areas of Yogyakarta Province. The sampling method is convenience sampling method because the geographical span of the Province and the implementation duration of the project that span 3 years. The e-learning readiness is measured before the implementation of the project by distributing questionnaires to the

teachers. All samples are tracked such that the respondents of e-learning readiness measurement and the respondents of technology acceptance model are the same teachers.

The e-learning readiness is measured using Chapnick's e-readiness model (Chapnick, 2000). However due to the nature of the project, only 5 out of 8 factors are measured. The 3 excluded factors are financial readiness and equipment readiness as the project was fully funded by JICA and block grant from the Provincial Government, and the schools are provided with necessary equipment to implement e-learning. Content readiness is also excluded as e-learning material suitable with national curriculum will be developed and provided by the Project. The digital content product of teaching material in multimedia format for subject matter of Mathematics for Elementary School Year 4, 5 and 6 and subject matter of Mathematics and Sciences (Physics, Biology and Chemistry) for Junior High School Year 7, 8 and 9 with a total of 75 topics has been developed and installed in the participating schools.

The 5 factors measured are psychological readiness (Psi), social readiness (Soc), environment readiness (Env), human resource readiness (Hum), and technological skill readiness (Tec). The result is shown in Figure 1.

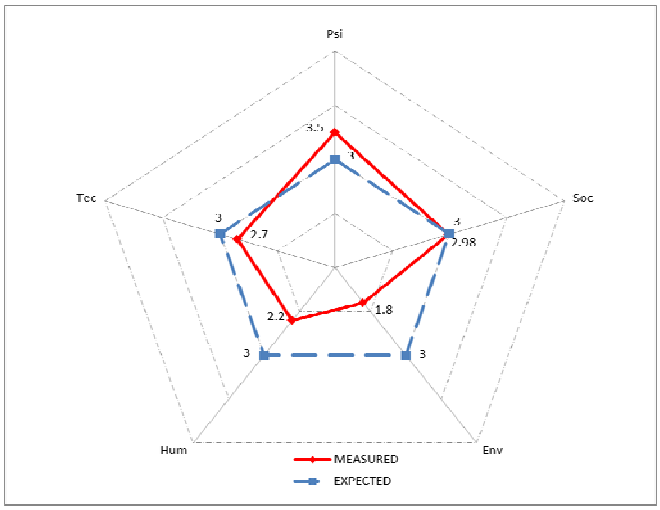

Figure 1. Measured e-readiness versus expected e-readiness in participating schools

It is shown that from Figure 1, psychological readiness is higher than what is expected. This shows that teachers and students in participating schools are very enthusiastic to be involved in the Project. Some observation and interviews confirm this. They are very eager to be selected as participating schools of the project and being included in the Project increase their motivation and increase also the school's reputation. High value of sociological readiness confirmed that Yogyakarta Province selection of the project was the right choice. Schools and teachers in Yogyakarta Province have sufficient interpersonal quality and culture to embrace ICT in their work. This is also confirmed by high percentage of teachers who own laptops and tablets than in other province in Indonesia. It is found that 89% of teachers own laptop or tablet.

Utilization of ICT in learning involved existing groups of teachers, both at the elementary and junior high schools. In elementary school domain, there are groups of teachers based on subjects or class called *Kelompok Kerja Guru* (teachers working group), while at the junior high schools there are groups of teachers based on the subjects referred to the *Musyawarah Guru Mata Pelajaran* (community of subject teachers). These forums aim to improve teachers' professionalism through systemically guided approach and active teaching and learning activities, and to improve the quality of taught subjects. The existence of the groups contributes to psychological readiness and sociological readiness as the groups facilitates teachers helping each other and sharing solution to the problems related to the development of teaching methods and materials.

However, while psychological readiness and sociological readiness are sufficient, the environment, human resource, and technological skill readiness are below expectation. There is a lack of support in this area from other stakeholders such as schools' inspector, parent association, and also lack of commitment from the school masters in some schools. It is found that ICT leaderships of the school masters, especially old school masters, are low. Many of them are still technologically backward and even have technophobia.

Junior high schools have ICT subject matter teacher with sufficient ICT skill available as ICT laboratory manager. Unfortunately their ICT skill is based on Microsoft platform which is not compatible with the selected

open source platform of the Project. Meanwhile elementary schools have only class teacher who teach every subject, so there is no teacher with sufficient ICT skill available. Besides that, elementary schools only have teachers and do not have administrative or support staff like in junior high or senior high schools, so they do not have ICT laboratory manager.

The low value of technological skill is due to the chosen platform of the project which is based on open source platform. The e-learning platform is based on OpenSUSE, a Linux distribution, while the students and teachers ICT skills are based on Microsoft platform as mandated by the National Curriculum from the Ministry of Education and Culture.

TECHNOLOGY ACCEPTANCE OF THE E-LEARNING SYSTEM

Before the e-learning system is implemented in learning process, further observation is made to formulate the right implementation strategy in order to ensure project success. Technology Acceptance Model (Davis, 1989) is employed to model how users accept and intent to use e-learning technology. Structural Equation Model (SEM) is applied for testing and estimating causal relations of factors that influence decision about how and when they will use e-learning when users are presented with a new technology.

The respondents of this survey are the same as the respondents of e-learning readiness measurement described in previous section. The data is taken after the respondents accomplish a training program on Linux environment and on the use of the e-learning in teaching-learning process. SmartPLS is used as analysis tool for path modeling of latent variables (Ringle, Wende & Will, 2005). Quality of the questionnaire is conducted by distributing the questionnaire to 100 respondents to perform reliability and validity test. The quality of the data can be seen from Table 1.

Table 1.Quality criteria of Linux questionnaire

	AVE	Composite Reliability	R Square	Cronbachs Alpha	Crossvalidated Redundancy	Crossvalidated Communality
INTENT	0.74	0.90	0.69	0.82	0.48	0.41
ATT	0.60	0.74	0.32	0.41	0.16	0.33
EASE	0.73	0.90		0.81	0.55	0.33
USEFUL	0.77	0.94	0.63	0.92	0.48	0.65

Using SmartPLS, the network is modeled into path diagram as shown in Figure 2.

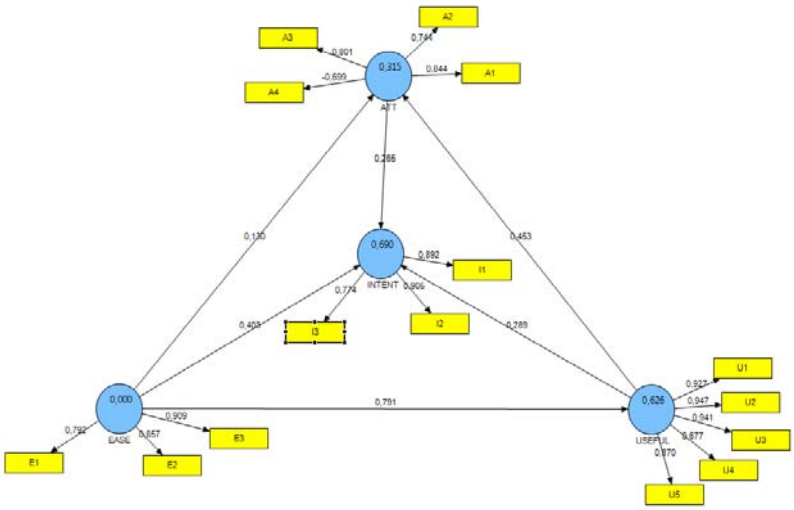

Figure 2. Path model for Linux acceptance from 100 schools. EASE = perceived ease of use, USEFUL = perceived usefulness (R^2 = 0.636), ATT = attitude toward using (R^2 = 0.315), INTENT = behavioral intent to use (R^2 =0.690)

Table 1 shows that all indicators have composite validity > 0.70, therefore the model is considered valid. The R^2 indicates that endogenous variables have either good (USEFUL, INTENT) or moderate (ATT). Perceived ease of

use is the strongest predictor for behavioral intent to use (0.403). The teachers expect that using Linux should be as easy as using Microsoft Windows. Perceived ease of use strongly affects perceived usefulness (0.791) while perceived usefulness strongly affect attitude toward using (0.453). However there is only perceived eased of use has significant effect to attitude toward using (0.403), but the other predictors only contribute moderate effects. This again confirms that teachers really do not care what the chosen platform is as long as it is easy to use.

Table 2. Bootstrapping Linux acceptance

	Original Sample (O)	Sample Mean (M)	Standard Error (STERR)	T Statistics (|O/STERR|)
ATT -> INTENT	0.27	0.26	0.09	2.94
EASE -> ATT	0.49	0.48	0.12	4.09
EASE -> INTENT	0.76	0.76	0.05	15.57
EASE -> USEFUL	0.80	0.85	0.05	16.42
USEFUL -> ATT	0.45	0.47	0.13	3.57
USEFUL -> INTENT	0.41	0.44	0.13	3.21

Bootstrapping the model as shown in Table 2 indicates that relationships are significant ($t > 1.96$) with perceived ease of use affect perceived of usefulness (0.80) and behavioral intent to use (0.76). An interesting finding is with indicator A4 which measured the question “I do not like to the idea of using Linux in my school” with a significant value of -0.699. The cross loading of indicator A4 shows also that this indicator has a high discriminant validity. Therefore it can be concluded that the choice of using Linux as the e-learning platform will not impact the outcome of the project as long as it is easy to use.

The survey is done to study factors related to the e-learning digital content using technology acceptance model to all respondents in 100 tracked sample schools after reliability and validity test.

Table 3. E-learning content acceptance data quality criteria

	AVE	Composite Reliability	R Square	Cronbachs Alpha	Crossvalidated Redundancy	Crossvalidated Communality
INTENT	0.82	0.93	0.83	0.89	0.65	0.60
ATT	0.72	0.82	0.75	0.55	0.51	0.55
EASE	0.73	0.91		0.87	0.53	0.53
USEFUL	0.79	0.94	0.76	0.91	0.57	0.63

From Table 3, it can be concluded that the data obtained is qualified for further processing. Using SmartPLS, the network is modeled as shown in Figure 3.

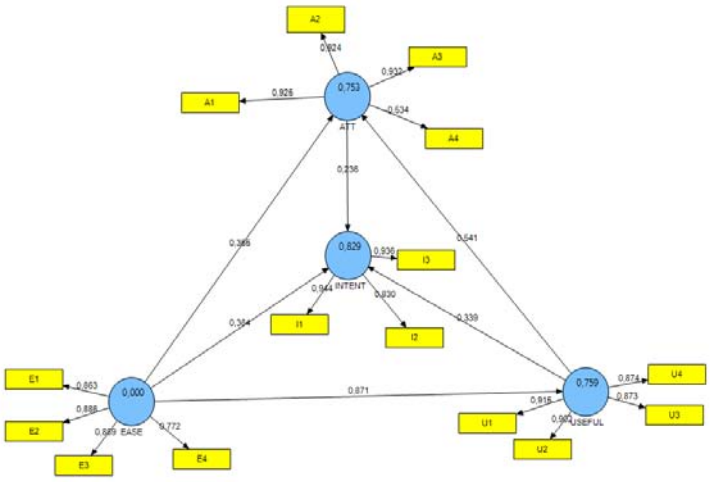

Figure 3. Path model for e-learning content acceptance of teachers in 100 sample school. EASE = perceived ease of use, USEFUL = perceived usefulness (R^2=0.759), ATT = attitude toward using (R^2 = 0.753), INTENT = behavioral intent to use (R^2 = 0.829)

Figure 3 shows that all indicators, except A4, have convergent validity > 0.70, therefore the model is considered valid. The R^2 indicates that all endogenous variables have either good (USEFUL, INTENT, and ATT). Perceived ease of use is the strongest predictor for behavioral intent to use (0.384).

Table 4. Bootstrapping e-learning content acceptance

	Original Sample (O)	Sample Mean (M)	Standard Error (STERR)	T Statistics (|O/STERR|)
ATT -> INTENT	0.24	0.24	0.10	2.26
EASE -> ATT	0.83	0.82	0.05	14.59
EASE -> INTENT	0.87	0.86	0.05	15.96
EASE -> USEFUL	0.87	0.86	0.05	17.18
USEFUL -> ATT	0.54	0.53	0.11	4.77
USEFUL -> INTENT	0.47	0.47	0.10	4.30

Bootstrapping the model shown in Table 4 indicates that relationships are significant (t > 1.96) with perceived ease of use strongly affect perceived of usefulness (0.87) and behavioral intent to use (0.87). Perceived ease of use strongly affects perceived usefulness (0.87) while perceived usefulness affect attitude toward using (0.54). All endogenous variables show significant effect to attitude toward using being the smallest (0.24). Further interviews reveal that there are several factors affecting this.

First is that culturally in Indonesia, in primary education the teacher is the “guru” with all its attributes even though some active learning efforts have been introduced recently. Secondly, teachers do not possess suitable didactic method in technology-supported learning environments. Some of their fear is that computer will replace their “guru” status. They mainly use computer for preparing slides, exam questions, or searching teaching materials, not for teaching subjects. Thirdly, subjects like Mathematics for example, most teachers consider as a very clerical subject with full of hands-on exercises so teacher’s physical presence is a mandatory.

An interesting finding is with indicator A4 which measured the question “I do not like to the idea of using e-learning for my subject as it will waste a lot of my time” with a moderate value of -0.534. The cross loading of indicator A4 shows also that this indicator has a high discriminant validity, but lower correlation with variable INTENT. This also confirms that there is a slight sense of insecurity of the teachers related to the e-learning implementation. Further interviews show that this insecurity feeling mostly occurs with teachers who are above 50 years of age which consist of 23% of the sample.

CONCLUSION

The study has shown that open source based e-learning can be implemented even in a low e-readiness environment such as in primary educations. The existence of teacher groups and forums where teachers share solutions and support each other contributes to the success of implementation in this kind of environment. Users in such environment accept whatever platform as long as they perceive it to be easy to use. It is also found that even all factors contribute significantly to the e-learning intention to use; there is also some feeling of insecurity especially among teachers with over 50 years old of age facing with modern technology.

The limitation of this study is the use of behavioral intent to use as a proxy to the expected outcome as the expected real outcome is not yet available. Therefore further investigation should be performed to measure the real outcome of the project in enhancing the quality of education from the national exam results after one full education cycle of participating students. A strategy to maximize the impact based on the findings of this research has been developed. The findings are also used to develop a roll out plan to replicate this project in other provinces.

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