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A MODEL FOR INTRODUCING FOSS IN EDUCATION IN GUYANA

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Abstract

In the context of the developing world, Free and Open Source Software (FOSS) presents both a challenge and an opportunity. The absence of strategic approaches for adopting FOSS is one possible explanation for the many challenges faced by developing countries. In particular, there is evidence that this problem pervades the education sector even though the education system provides an opportune learning space for the early exposure of the future workforce to FOSS. It is therefore strategically important to identify opportunities within the education system to introduce FOSS. In this study, we propose a user-centric model for the introduction of FOSS in the education sector in Guyana. We develop this model using factors extracted from technology acceptance and adoption models, and preliminary data from interviews conducted with Information Technology users and educators in Guyana. Our model comprises three distinct stages and four phases: FOSS Introduction, FOSS Proliferation, and FOSS Sustenance. The FOSS Introduction phase addresses FOSS distribution and training. The FOSS Proliferation Phase addresses strategies for the promotion of FOSS, and the FOSS Sustenance phase focuses on policy development. These stages are iterative but they provide feedback experiences into previous stages for further iteration. We noted promising results from a preliminary evaluation of Stage 1 of our model.

Key words*:* FOSS, Open Source Software, Proprietary Software, FOSS in Education

1. Introduction

The use of Free and Open Source Software (FOSS) has been identified as an important strategy for solving many of the issues associated with the acquisition and use of Information Technology. The use of FOSS is even more critical for developing countries as it provides a means for solving

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many of the problems specific to these nations. Camara and Fonseca (2007) argued that FOSS can be used by developing countries to reduce the costs associated with proprietary software, promote technological development and bridge the digital divide. Specifically, Mtsweni and Biermann (2008b) reasons that governments can benefit from the cost-effectiveness of FOSS, no vendor lock-in, improved security, flexibility, and people development. To address these issues, many governments in the developing world are taking steps towards the development and implementation of FOSS policies (Dudley-Sponaugle, Hong, & Wang, 2007). In the context of sustainable economic development, access to information, technological learning and adaptation are important factors (Camara & Fonseca, 2007).

At the local level, the Government of Guyana has indicated its interest in the use of FOSS in the national development program of the country. The Guyana National ICT4D Strategy of 2006 (ICT4D, 2006) specifically noted that the use of Free and Open Source Software (FOSS) will be explored. However, systematic approaches towards the implementation of specific programs and policies for FOSS integration need to be executed. Specifically, in the education sector in Guyana emphasis is placed on literacy and practical technology (*MOE*, 2012). However, lack of access to resources has plagued rapid development. These problems affect the development of Information Technology significantly, as many school laboratories are ill-equipped. However, this is changing with more schools being equipped with computer labs. In addition, access to computers has been facilitated through government and interested private institutions and individuals. At the primary level, most schools do not feature student access to computers on a regular basis. In cases where computer labs are available, proprietary software dominates. FOSS can be seen as a possible solution to this problem since it will provide free software and access to a wider range of hardware.

To address some of the challenges faced by developing countries, International support for introducing technology in the education sector is beginning to emerge. For example, The Commonwealth of Learning (COL) and UNESCO held a Forum on ICT use in the Caribbean (COL, 2012) of which Guyana was a beneficiary. At this forum, it was acknowledged that open educational resources are being underutilized. However, much more emphasis has to be placed on the development of policies and support programs to practically implement the use of Open Educational Resources in general, and FOSS in particular.

1.1. FOSS in Education: A Brief Review

In education, many discussions on the potential benefits of using FOSS are taking place. There are many positive arguments for the introduction of FOSS in education (Williams van Rooij,

2007; Williams van Rooij, 2009). However, many challenges have also influenced the introduction of FOSS in education. The factors include technical, policy, perception (Johnston, Begg, & Tanner, 2013) and cultural issues (Williams van Rooij, 2011).

In the area of teaching and learning, evidence of FOSS in education is noted. Lipaya and Laramee (2011) explored a number of FOSS tools in Computer Science and IT courses. They reported a number of benefits and drawbacks from their case studies. Further, Morelli et al. (2009) have demonstrated using a number of practical case studies, the value of FOSS projects that have emerged from education. They have also demonstrated FOSS projects that were systematically set up to support the development of students through improved educational methods. In the area of learning management, Wang, Blue and Plourde (2010) reported on the successful deployment of an open source tool (Sakai) at the University of Delaware. Similarly, Lakhan and Jhunjhunwala (2008) have described a successful integration of FOSS tools (MOODLE) in online learning.

In terms of research, Tomazin and Gradisar (2007) conducted a study in Slovenia on the use of FOSS. Participants were involved in using FOSS such as OpenOffice and the Linux Operating System. They noted that FOSS is not being used to its fullest potential in education, despite its noted similarity with proprietary software. The study also suggested that the lack of training provided to teachers in the use of FOSS may have prevented them from delivering the same in their classrooms.

1.2. Technology Acceptance Models

In general, a number of models have been used to explain the acceptance and adoption of technology by users and organizations (Jairak, Praneetpolgrang, & Mekhabunchakij, 2009). However, in this study we focus on two particular models to guide the development of our model: The Unified Theory of Acceptance of Use of Technology (UTAUT) model and the Technology-Organization-Environment (TOE) framework.

The Unified Theory of Acceptance of Use of Technology (UTAUT) model was developed by Venkatesh et al. (2003). The model is generally used to assess the likelihood of acceptance of a new technology according to the authors. They further suggested that this model can target populations that are less likely to 'adopt and use new systems'. The authors theorized that the four factors of UTAUT model - '*performance expectancy*', '*effort expectancy*', '*social influence*' and '*facilitating conditions*' are 'significant determinants of user acceptance and usage behaviour' (Venkatesh et al., 2003). In this context, we believe that special emphasis on end-user development is important for the realization of this model. Our model is hypothesized to

influence these factors through the provision of training and support to end users, promotion of FOSS, and policy development and support from educational leaders.

The Technology-Organization-Environment (TOE) framework has been used for many years to understand how organizations adopt technology (Morgan & Finnegan, 2007). This model focuses on three main factors in technology, organization and environment. However, the model does not focus on the individual user. This factor is noted as an important aspect of the introduction of Free and Open Source Software according to Morgan and Finnegan (2007). Further, user resistance and resistance to change were cited as critical factors affecting the introduction of FOSS in organizations (Johnston & Seymour, 2005; Mtsweni & Biermann, 2008a).

A model based on cost savings have been proposed for the introduction of FOSS in education (Shaame, Shanmugam & Dehghantanha, 2013). However, this model is very descriptive and does not provide specific guidelines for the implementation of FOSS. This model has not been tested.

In the context of the models analysed above, we believe that it is important to place particular emphasis on the end-user in our proposed model. We believe that introducing the end user to FOSS in a supportive environment will impact FOSS adoption.

1.3. The Proposed Model

The following framework is proposed to introduce FOSS in education institutions in Guyana.

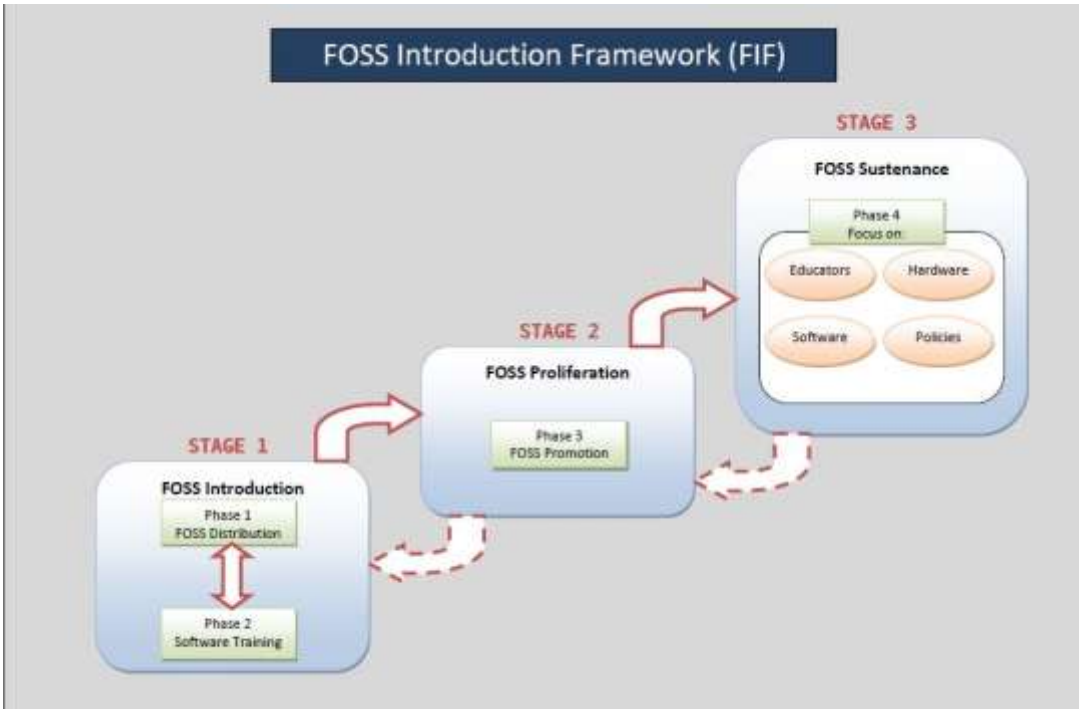

Figure 1. *FOSS Introduction Framework (FIM)*

1.4. Description of the model

FOSS Introduction

Phase 1

At Phase 1 of our model FOSS will be provided to each school and tertiary institution in Guyana equipped with a computer laboratory. FOSS tools will be distributed on portable storage. Internet connectivity is not available in all schools and therefore portable distribution is preferred over downloads.

At this phase, installation of software is also important. All supporting institutions will receive support to install software. This is important as schools may not have technical expertise to install the software.

Phase 2

At this phase, training on the use of FOSS tools will be provided. This will complement existing proprietary software training. Training sessions will be conducted to demonstrate FOSS use and to assist users to become familiar with features and functions of these tools. This training will build familiarity with the interface and help reduce their initial apprehension to using FOSS. Training would also introduce the teachers to a wide range of FOSS tools. Additional software needed by teachers will be explored and identified during this phase.

FOSS training will be conducted simultaneously with the use of proprietary software to demonstrate that training would not be exclusive of any specific type of software. Training at this stage will focus exclusively on Teachers.

FOSS Proliferation

Phase 3

The use of FOSS will be encouraged at all levels of education. In addition to the school system, University lecturers will be encouraged to use FOSS. This is especially important for Information Technology and Computer Science programs. Statistical, mathematical, chemistry, medical databases and other software tools will be demonstrated. The administration officers of educational institutions will also be exposed to FOSS issues and will be encouraged to use FOSS.

At the University level, FOSS use will be encouraged since exposure to the usefulness and benefits of FOSS at this level will help with the direct transfer of knowledge into the world outside the university through graduates. Further, software development using FOSS and of

FOSS itself are important skills to be developed. The university is perhaps the best level to introduce this level of FOSS activities.

Administrators such as Heads of Department, Head Teachers and Regional officers will be contacted and educated on the use of FOSS since they are responsible with the policy and procedures and can encourage FOSS use in educational facilities.

A further step to encourage the use of FOSS will be to discourage the use of proprietary software that is pirated. Legal software installations must be made mandatory. This will ensure that FOSS is explored as priority when there is a software need.

FOSS Sustenance

Phase 4

The sustenance of new FOSS initiatives is critical for the proliferation of FOSS in education. In this phase, we argue and propose that greater focus on maintaining high usages levels has to be encouraged. To succeed at this stage, four areas must be constantly monitored:

- The Educators;
- The Hardware;
- The Software;
- Policies.

Educators

Teachers will be used to administer FOSS training in schools, colleges and other institutes. Teachers should also be allowed to receive training that covers different grade levels so that they are prepared if reassigned to another level. Incentives to encourage and motivate usage and skills retention are recommended.

Hardware

Computer hardware specifications are constantly changing. To ensure that hardware required for FOSS demands are current, periodic hardware upgrades are recommended. This will be determined by scheduled maintenance on computers. Since FOSS' hardware requirements are lower than proprietary, older equipment will be put to good use if careful planning is executed.

Software

FOSS is easily updated across the Internet (where available). In cases where Internet connections are unavailable, facilitators will be contacted to effect periodic software upgrades/maintenance or when required.

Policies

A policy for the integration of FOSS must be developed by each institution. This could be guided and supported by the Ministry of Education. This phase is critical for the long-term sustainability of any FOSS-based education system.

2. Design and Preliminary Evaluation of Model

2.1. Methodology

To further assist with the development of our model, we conducted a survey of twenty one (21) schools about their current Information Technology (IT) Infrastructure, IT policies, and management of IT within their schools. This purpose of this survey was to develop a better understanding of the current IT environment of the schools and the implementation issues and challenges facing schools. We also asked about awareness of FOSS.

To evaluate our proposed model, we executed three Software Training Sessions as part of Stage 1 and Phase 1 and 2 of our proposed model. At this stage, we are interested in observing the effects of FOSS distribution and training. In particular, we proposed parallel training sessions to evaluate and compare performances and perceptions when both proprietary and open source software are used. Participants were identified based on availability and place into one of three groups and the methodology was executed as described below:

The following design was used to test the use of Proprietary and Open Source software:

Introduce Participants to Software Functionality
Demonstrate functionality in Proprietary solution
Demonstrate functionality in Open Source solution
Place participants randomly into three Practice Groups for training:

- Group 1 – Participants trained only in Proprietary Solution;
- Group 2 – Participants trained only in FOSS solution;
- Group 3 - Participants trained both in Proprietary software and FOSS.

Administer practice sheets to all participants after training session to clarify understanding and develop further skills

Administer the same Assessment to all participants to evaluate performance

Analyse the results of assessment to ascertain the following:

- performance among groups;
- level of comfort with software;
- mastery of skills;
- difficulties encountered while using teaching and learning FOSS.

The software used in the training exercises was:

- Spreadsheet - Microsoft Excel (Proprietary) and Open Office Calc (FOSS);
- Web Design – Macromedia Dreamweaver(Proprietary and Kompozer (FOSS).

At the end of these training sessions, a survey was administered to participants to solicit their views and perceptions of the tools used.

3. Results

3.1. Survey Results

All of the twenty-one schools surveyed owned computers. However, two of the schools do not have computer laboratories set up due to electrical issues. Eight of the schools had Internet connections. Of those that have Internet connections, 2 had 1Mbps connections. The others have slower speed 128 kbps or 256 kbps connections. On average, there were three to four IT teachers at each school. 5/21 schools claimed to have an IT policy. This policy was supplied by the Ministry of Education. The remainder of the schools claimed to have only 'Lab Rules' that were created by the schools.

The IT laboratories are managed by the head of department in 11/21 of the schools. In most cases, the head of department was also an IT teacher. 8/21 schools were managed by an IT teacher other than the head of department. The remainder was managed either by the Head Teacher or the Ministry of Education.

3.2. Software Training Results

The best performing group was Group 1 - Proprietary applications: Dreamweaver and Excel. The next best performing group was Group 2 – those using both the FOSS application and the proprietary application. The FOSS only group performed the poorest. In terms of perceptions of

FOSS tools, the group that was exposed to both proprietary and FOSS tools responded most positively. 100% of participants who used the FOSS application indicated that they are likely or highly likely to use the software again. They suggested that the interface was simple, friendly and efficient to use.

A number of challenges were noted during the training sessions. It was observed that the FOSS applications lacked some of the features of the proprietary application. Participants pointed out these differences as they affected the completion of the assigned tasks.

4. Discussion and Conclusion

The survey results indicated that many of the schools are equipped with computer laboratories. These schools also appear to have an adequate number of Information Technology teachers. The availability of computing facilities is critical for the successful implementation of our model as it provides the foundation for all activities. The computing needs of the schools seem to be limited to a small number of software applications. Proprietary Office Applications, File management tools and web browsers were the main software tools used.

Many of the schools surveyed do not have an official IT policy document. In the absence of this document, schools make decisions based on their own experience and available resources. This situation is not ideal, since having a policy document supports standardization and a unified approach to the problem of software sourcing. In instances where policies exist, specific mentions of FOSS tools are absent from these documents. Our model specifically addresses the development of FOSS policies.

Preliminary results from the software training sessions suggest that training in FOSS can be effective for users that are already familiar with proprietary software. Perhaps this is an indication that exposure to both types of applications may be essential to consider when introducing FOSS applications. Further, we noted that the group that was exposed only to FOSS applications did not perform effectively on the tasks assigned. This is perhaps a further case in support of the exposure to both types of applications for effective FOSS implementation. A further potential benefit of this dual arrangement is that it can create the impression to end users that both types of applications can co-exist. In our model, we suggest the training should feature both types of software.

In general, it has been noted that typical computer users are not interested in open source tools merely for their openness (Lakhan, 2008). End users prefer functionality and support. Advocacy

programs and institutional policies that promote its use, together with specific training programs are essential for the successful implementation of FOSS. In this paper, we propose a practical model for the implementation of FOSS in Education.

5. Limitation and Future Work

This proposed model has not been extensively tested and therefore remains mainly theoretical. Evaluations on only one of the three stages were conducted. To validate this model, extensive evaluation is recommended across the entire three stages and four phases. We are also unable at this time to estimate the cost of implementing this model. We recognize that this is an important consideration and therefore subsequent examination of the model should include a cost analysis. At this stage the FIF model proposed in this paper should be treated as tentative.

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