Open Source Software in Information Technology Education

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Abstract—**As Malaysia strengthens its position as an outsourcing hub, there continues to be many job opportunities in information technology in Malaysia. This paper looks at the ranking of open source software skills in demand. Further, it provides insights into graduates' perception of usefulness for courses using open source software versus proprietary software at a local institution of higher learning.**

Keywords-open source; information technology; education; skills

I. INTRODUCTION

The term "open source" frequently refers to software development process that relies on the contributions of geographically dispersed developers via the Internet [3]. The terms "free software" and "open source software" are interchangeable [1]. Essentially, Applebe (2003) emphasized that "free software" means "free(dom) to modify the program's source code", not "at no cost". It has been said that open source software continues to receive immense attention worldwide because of the success of products such as Linux and Apache, the uneasiness about the Microsoft monopoly in the software industry and 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 [2].

At the country level of analysis, research has shown that ASEAN countries with a GDP in purchasing power parity per capita less than USD$10,000 and with at least 5% of the population already using the Internet are amongst the highest adopters of open source software in the ASEAN bloc. This includes Indonesia, Malaysia, Phillippines, Thailand and Vietnam [4]. At the software system level of analysis, research has shown 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 [5].

The Malaysian government has been aggressively promoting free and open source software in Malaysia's public sector (refer to http://opensource.mampu.gov.my) through the Malaysia Administration and Modernisation Planning Unit. As a testimony of commitment, the government established the Open Source Competency Centre (OSCC) as a national reference centre to lead and support OSS implementation in the public sector.

This paper describes a part of an on-going research on the adoption of open source software in information technology education at a leading institution of higher learning in Malaysia. The research attempts to understand:

- the ranking of open source software skills for entry level information technology graduates
- graduates' perceived usefulness with courses that adopt open source software.

The second section provides the methodology of this part of the research. Consequently, we present the results. Finally, the paper concludes with lessons learnt and recommendations.

II. METHODOLOGY

In achieving the first research aim, we used a secondary data source from the Malaysian Multimedia Development Corporation (a government agency entrusted to drive the transformation of the nation into a knowledge-based society) released the skill sets required in Malaysia to propel the software industry. We also conducted a content analysis of major job portals in Malaysia for a two-month period in year 2008 to complement the use of secondary data source. To fulfill the second research aim, we conducted a cross-sectional survey of bachelor degree graduates in information technology in 2007 convocation ceremony. We distributed 56 questionnaires. Respondents were required to evaluate agreement to statements on all courses required for the fulfillment of the Bachelor of Information Technology program. All questions used a five-point Likert scale. A five-point represented extremely useful while a one-point representing not at all useful. Responses were mandatory for those who those attended the convocation.

III. FINDINGS

The findings in this section are organized in two parts: the first part reviews the ranking of open source software skills for entry level information technology graduates and

the second part on perceived usefulness of courses that adopt open source software.

A. Ranking open source software skills

In 2007, based on Malaysian Multimedia Development Corporation, open source software skill was ranked at number five of the most required skills in Malaysia (see Figure 1) through the demand of MySQL. This is next to Java/J2EE and Microsoft.NET skills.

Figure 1. Skill Demands in Malaysia for Software Industry in 2007

Figure 2 shows the results of the findings for the content analysis study of major job portals in Malaysia.

Figure 2. Skill Demands in Malaysia for Software Market in 2008

Database skills are ranked as the most needed skill by most job employers surveyed. This covers MySQL database. Besides, JAVA and PHP programming were ranked among the top technical or programming skills required to boost the software industry in Malaysia. This could be attributable to Malaysia' s position as one of the most appealing destination for outsourcing. In 2007, AT Kearney Inc.'s Global Service Location Index ranked Malaysia as the world's third most ideal outsourcing destination. In the same year, Frost & Sullivan Inc.'s Global Shared Services and Outsourcing (SSO) Hub placed Malaysia as one of the top five most preferred locations in the world for SSO. [i]

B. Perceptions of usefulness of courses that adopt open source software courses

Out of 77 who graduated with a Bachelor degree in Information Technology in 2007, only 56 responded to the questionnaires (72.7%). Figure 3 shows the gender profile of respondents.
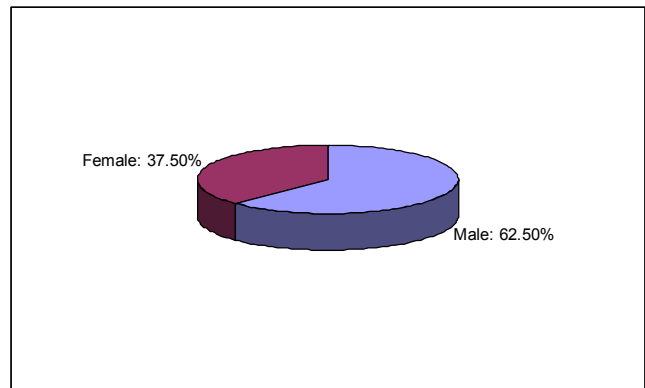

Figure 3. Gender Profile of Respondents

The majority of respondents were male. Mostly reported they took almost eight semesters to complete the programme (mean=7.69). Mostly cited that they chose the programme because of their own inclination to do so. The average CGPA for the respondents was 2.92.

We calculated the percentage of courses that provide open source software exposure. Out of 128 credit hours required for graduation, students spent 21 credit hours (16.4%) on using or applying open source software. Students are exposed to seven courses that have open source software and technology embedded in them:

- Structured Programming Language
- Object-oriented Programming
- Database Programming
- Systems Analysis & Design
- Web Programming
- Final Year Project I
- Final Year Project II

Table I shows the description of the courses.

TABLE I. COURSES MAKING USE OF OPEN SOURCE SOFRWARE AND THEIR DESCRIPTIONS

	Course	Course Description
1	Structured Programming Language	The course emphasizes the fundamentals of structured programming using C++. Students learn the techniques, architectural, design issues and basics about class and object.
2	Object oriented programming	In this course, students learn object oriented programming techniques including classes and objects, decision construct, methods, inheritance, encapsulation, polymorphism and overloading in Java.
3	Database Programming	The course covers the introduction to database, database environment, relational model, relational algebra, SQL, database planning, design and administration, entity relationship modeling, enhanced entity relationship, normalization, methodology such as conceptual database design, logical database design, physical database design and monitoring and tuning the operational system.
4	Systems Analysis & Design	The course introduces concepts and practices of the information systems development process, with an emphasis on object oriented approach. Students are exposed to analysis requirements and design specification methods.
5	Web Programming	In this course, students are exposed beyond basic HTML presentation in web development. Students learn how to build dynamic web services and active contents by integrating the HTML with server-side scripting language such as PHP and MySQL for the database. In addition to learning the basic programming techniques, students are exposed to other issues related to the process of web development such as client-server architecture, usability, testing configuration management and internet security.
6	Final Year Project I	Students are expected to integrate prior knowledge acquired in systems analysis and design, project management and programming in this course by going through a complete lifecycle of system development process.
7	Final Year Project II	

We then analyzed graduates' perceived usefulness of the courses because of the application of open source software tools in them (see Table II).

TABLE II. GRADUATES' PERCEIVED USEFULNESS OF COURSES MAKING USE OF OPEN SOURCE SOFTWARE

	Courses	Open Source Software used	Mean
1	Structured Programming Language	GCC compiler	4.26
2	Object oriented programming	JAVA programming language by Sun Microsystems	4.25
3	Database Programming	MySQL	4.43
4	Systems Analysis & Design	Star UML	4.38
5	Web Programming	PHP, MYSQL, WAMP, LAMP Apache Tomcat J2SE	4.53
6	Final Year Project I	All of the above	4.54
7	Final Year Project II	All of the above	4.49

The majority of graduates surveyed were satisfied with courses that adopted open source software. The highest evaluation for perceived usefulness comes from Final Year Project I, Web Programming and Final Year Project II courses although many had complained that the courses were tough. We analyzed the frequency of responses for each of the course (see Table III).

TABLE III. FREQUENCY DISTRIBUTION FOR GRADUATES' PERCEIVED USEFULNESS WITH COURSES MAKING USE OF OPEN SOURCE SOFRWARE

	Courses	1	2	3	4	5
1	Structured Programming Language	-	1 / 1.8%	10 / 17.9%	21 / 37.5%	24 / 42.9%
2	Object oriented programming	-	-	7 / 12.5%	28 / 50.0%	21 / 37.5%
3	Database Programming	-	-	6 / 10.7%	29 / 51.8%	21 / 37.5%
4	Systems Analysis & Design	-	-	7 / 12.5%	21 / 37.5%	28 / 50.0%
5	Web Programming	-	-	3 / 5.4%	19 / 33.9%	31 / 55.4%
6	Final Year Project I	-	1 / 1.8%	2 / 3.6%	19 / 33.9%	34 / 60.7%
7	Final Year Project II	-	1 / 1.8%	3 / 5.4%	19 / 33.9%	32 / 57.1%

1: Not at all useful; 2: A bit useful; 3: Neutral; 4: Useful; 5: Extremely useful

All the above courses were required courses for graduation. Web Programming was an elective course.

We then analyzed courses namely Multimedia Technology, Creative Design Techniques and Animation Techniques that made use of proprietary software i.e. Adobe. Except for Multimedia Technology, the other courses were electives. Because the two were elective courses, some graduates may not take the courses.

TABLE IV.   GRADUATES' PERCEIVED USEFULNESS WITH COURSES
MAKING USE OF PROPRIETARY SOFTWARE

	Courses	Mean
1	Multimedia Technology	4.02
2	Creative Design	4.23
3	Animation Techniques	4.12

We note that from this part of our analysis, our graduates evaluated higher for perceived usefulness of courses that used open source software. As evident from Table IV, the mean rating for all three courses using proprietary software were lower than those courses that made use of proprietary software. We then compared this finding with the secondary data source and the result of our content analysis as presented earlier. Our finding here seems to be in line with the earlier findings in that perceived usefulness of open source software courses with regard to industry demands ranked higher than that for proprietary courses; at least MySQL and JAVA skills ranked higher than Adobe Photoshop.

IV.   CONCLUSIONS, RECOMMENDATIONS AND STATUS

There are many job opportunities in information technology in Malaysia as the country strengthens its position as an outsourcing hub. The International Data Corporation (IDC) estimates that by 2010, 98,000 job vacancies will be created out of the initiatives already spearheaded by the government (source: Harian Metro, 23 January 2008). Graduates need to prepare themselves to fulfill industry's needs, changing technology and challenging market demands. Likewise, college education needs to stay relevant to meet industry's expectations by providing the necessary foundation and exposure to students so that they are ready for the job market when they leave the campus.

Based on secondary data source in 2007 and content analysis performed in 2008, there is an evidence to suggest that skills in open source software will continue to be in demand in industries in Malaysia. Our analysis of graduates' perceptions suggests that exposure to open source software in undergraduate information technology education was useful for them in preparing them for the job market. Hence, educators in institutions of higher learning may consider reviewing the composition of open source software in their curriculum.

In terms of practical implications, we are strengthening our curriculum by providing more hands-on approach to enhancing skills in open source software technology. Web Programming is now a mandatory course. There is now an advanced level of Web Programming. The focus is on Java web technologies such as Java Server Pages (JSP), Servlet, Java Bean, JDBC and Java Server Faces (JSF). Students learn data exchange technology with XML and administer Apache Tomcat (open source web server) in this course. In preparing for the advanced level course, students are now required to undergo an additional Mathematics course at the first year level. We believe that this will help students be more competitive in the job marketplace.

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ENDNOTES

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