Enhancing the Capability of Knowledge Worker To Be : A Study on Programming Skill Competency Among ICT Undergraduates

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ABSTRACT
The aim of the research is to investigate the technical capability of knowledge worker to be. In this research knowledge worker to be refers to ICT graduates in local universities in Malaysia, focusing on programming skill. In order to achieve the objective, mixed method triangulation approach is used and it involved three main groups which are undergraduates, university and industry. Based on the findings, without good strategies from university, students might face difficulties to understand the important of programming skills. Industry required qualified ICT graduates to fulfill the industry needs. Pertaining to this matter, this research suggested the enhancement in existing teaching design which would help the educators to design and vary their ways of teaching to ensure the students have better understanding of programming and furthermore producing quality graduates as required by industry.

Keywords: knowledge worker, programming competency, unemployment.

1 INTRODUCTION
Knowledge workers are a growing sector of the workforce (Haag, Cummings, & Phillips, 2008). They are individuals valued for their ability to gather, analyze, interpret, and synthesize information within specific subject areas to advance the overall understanding of those areas and allow organizations to make better decisions. The knowledge worker is the backbone of many professions. Within the federal government, entire agencies are mainly comprised by knowledge workers.

Today, Malaysia is one of the countries in the world that acknowledged the importance of Information Communication Technology (ICT) to generate the economic and also ensuring the values of ICT in this country concurrent with world class infrastructure. In order to be a competitive intelligent country, Malaysia government has provided many ICT facilities in the society to ensure the values of ICT functioned as a vital role among Malaysian. Due to this reason, the government also has invested heavily in enhancing the infrastructure of ICT technology in this country for in every aspects of development. The launch of the Multimedia Super Corridor (MSC) in 1996, under the National Information Technology Council (NITC) is a strategic step from government to ensure the growth of ICT in Malaysia. With this growth, the need to have knowledge workers focusing on ICT skills is very high.

In order to materialize this, Ministry of Higher Education(MoHE) has streamlined the ICT courses in universities into three (3) main courses which are Bachelor of Information Technology, Bachelor of Computer Science (CS), and Bachelor of Software Engineering. The courses would place emphasis on strong fundamentals in mathematics and programming. The courses would also incorporate soft skill and entrepreneurship training to produce more street savvy graduates as opposed to book savvy ones. A regular review of the curricula is expected, looking into the areas of specialization; software engineering, software testing, software design and modeling, computer and information systems, artificial intelligence, multimedia, healthcare and biotechnology, all of which are subject to external review as well.

Although MoHE has paid much effort on tackling this issue, Malaysia is reported to have a worrying figure of unemployed graduates. According to statistics from the Department of Statistics Malaysia (DoS), up to December 2012 Malaysia’s unemployment rate is 3.3 percent. That means about 434,000 Malaysian were unemployed in comparison to labor force of slightly above 13 million in Malaysia. What is more alarming is that the percentage of unemployed graduates in the field of Science, Mathematics and Computing is ranked at third place and shown the 17.9% distribution of unemployed graduates in this field(as shown in Figure 1).
In developing strategic plans to address the ICT talent requirements of companies in Malaysia, MDeC (Malaysia Development Corporation) conducted a survey on ICT talent requirements of companies in Malaysia (2013). The result of the survey indicated that software development is the most needed skill (refer to figure 2). This indicated that programming competency is very important that need to be acquired by ICT graduates in order to fulfill the industry needs. These alarming figures called for a study to address the issue above. Therefore this study intended to find out the possible solutions for universities in order to produce qualified and competent graduates to match expectations from employers.

II KNOWLEDGE WORKER

Knowledge workers are generally professionals such as software engineers, teachers, lawyers, architects, physicians, nurses, engineers, and scientists. As businesses increase their dependence on information technology, the number of fields in which knowledge workers must operate has expanded dramatically.

The term was first coined by Peter Drucker in 1959, and later refined in 1999, as one who works primarily with information or one who develops and uses knowledge in the workplace (Drucker, 1973, 1999). Some tasks that are performed by the acquisition community do not fall within the definition of knowledge work; however, those aspects that involve making judgments and trade-off decisions clearly do.

Drucker (2001) added to the definition of knowledge workers by describing their fundamental tasks.

“To be sure, the fundamental task of management remains the same: to make people capable of joint performance through common goals, common values, the right structure, and the training and development they need to perform and to respond to change. But the very meaning of this task has changed, if only because the performance of management has converted the workforce from one composed largely of unskilled laborers to one of highly educated knowledge workers”.

Creating environments and solutions to encourage high performance among knowledge workers is an area long neglected by researchers. Furthermore, to date, no published research exists on how to produce well-equipped knowledge workers. One important skill that a knowledge worker in ICT field needed is programming skill.

III METHOD

This research study was conducted by using of mixed method triangulation approach. This method approach is the combination of both quantitative and qualitative data and it focuses on collecting, analyzing, in a single study or series of studies.

Questionnaires were constructed to collect the variation of students’ perception about learning programming and related issues among CS undergraduates. The questionnaire distributed to this group and the key questions were:

- Students interest in learning programming.
- Factors that affect students interest in learning programming.
• Satisfaction of programming courses been taught in university
• The initiatives that can be done to help them more versed in learning programming
• Students interest in becoming a programmer after graduation
• Capability of completing a complete programming after graduation
• Student’s expectations on how university may help them in process of learning programming by providing facilities and a better surrounding.

The questionnaire survey were distributed to 166 students from of Bachelor in Science Computer was selected randomly from Faculty of Computer Science in one of the public universities in Malaysia. The participated students are from second and third semester. All the participants were selected randomly based on the scope of this research to understand their perception of learning programming.

Employers and educators were selected for the interview conducted from 17th May until 31st 2013 over a period of about two weeks and the data was evaluated using Convenient Sample and Judgement Sample Strategies (Marshall, 1996).

i. Convenient Sample Strategy
Convenient sample strategy used in this research study because this technique is the least rigorous, involving the selection of the most accessible subjects. This technique also least costly, in terms of time, effort and money, but may result in poor quality data and lacks intellectual credibility. There is an element of convenience sampling in many qualitative studies, but a more thoughtful approach to selection of a sample is usually justified.

ii. Judgement Sample Strategy
The judgement sample is continuing from convenient sampling and also known as purposive sample and authoritative sampling. This technique is the most common sampling in qualitative research. This strategy is non-probability sampling technique where the participants involved are based on their knowledge and professional judgement. Participants involved are individuals with specialty and experience in their field and the results are more accurate compared to other probability sample technique. In this research study, from university perspective, researcher wants to know the techniques on how educators teach programming to undergraduates in class and the educators to be interviewed are specific to educators with experience teaching programming courses. And, from industry, the capable participants are selected in the interview to identity their perception of current Malaysian graduates in programming and what they feel of quality education in Malaysia education.

This research method intended to illuminate rather than provide generalisation findings. The selection of employer case studies, therefore, is purposive but aimed to reflect a range of employer types, sizes and sectors.

Interview conducted with employers from industry as purpose to understand industry’s required from graduates. A semi-structured interview was conducted with the several employers from ICT sector concerning their perspective, thought and opinions to help university and academia to produce better quality graduates in programming skills. The interviews were conducted with informant’s representatives from ICT companies. The people that were selected are from different level of designations which are head of department, senior manager, technical manager and also programmers. The individual that have been interviewed are people in background of information technology, computer science, or engineering.

They are particular people who had experience working in either private or government sectors. Each interview was held at the individual’s workplace. Each interview sessions were done by visit at a time. ICT companies selected based on their background in develop standard software applications. Each interview was handled as private discussion to avoid any ethical issues and a declaration form was prepared for every participants. The declaration informed the participants that the interview sessions will be recorded and the outcome from this research is for education purposes only.

Interviews with industries are aimed to find out the perceptions of employers concerning the programming skills among fresh graduates, in other words, to identify the programming skills required by undergraduates in order to fulfill the current industry demands.

Interview with educators was conducted to find out the perceptions of educators concerning the programming skills, knowledge and characteristics on how university helps undergraduates to be more marketable. The purpose of this interview is to determine whether the current curriculum which is offered in the university does match with the industry needs. In this researcher, the perception from educators will concentrate more on novice students due to find the issues that were started influencing students from the beginning of learning programming.
IV CASE STUDY BACKGROUND

University M is a public university (IPTA) and was established on December 1, 2000. In line with the government’s aim to fulfill the human resource needs of Malaysia’s industries, University M’s programmes are tailored with input from various industries in order to create graduates that match the demands of the industry. As this study focuses on graduates of computer science degrees-related and the used of practical method in University M that is emphasized in teaching, University M is the best example of public university to be selected as case study for this research to clearly understand on how programming skills has been practiced on computer science undergraduate students.

Faculty of Information and Communication Technology (FICT) in University M offers Diploma and Bachelor for undergraduate. For Bachelor of Computer Science course, FTMK offered seven (7) majors which are Software Development, Computer Networking, Artificial Intelligence, Interactive Media/Multimedia, Computer Security, Database Management and Game Technology. In University M, programming subjects are offered in two main faculties, FICT and Faculty of Electrical Engineering (FEE). The objectives of this course in preparing knowledge in scientific concepts and principles of the latest computer technology and software development and also to equip the students with software development assessment, tools, software and mathematical sciences in preparation for their professional life as well as career to meet the rapidly changing demands of modern society. In keeping with the university’s mission, the faculty is committed to providing high quality program of study and making FICT the number one faculty in producing knowledgeable and competent graduates in order to fulfill the aspirations of the nation’s development.

The content of this course covers the computer problem solving, operating systems, database, software engineering, programming, computers security, networking as well as Mathematics and English. These majors also offering extracurricular activities to shape students mind and body to be strong and versatile individuals and capable to cope with the demanding computing work environment.

V DISCUSSION

A. Student’s Expectation

Through the findings, this research concluded that many students face difficulties, especially to develop enthusiasm in learning programming. The negative perception of programming also influenced them, factors that might affects their first impression before entering programming course are such as rumors from seniors saying programming is hard to learn, the programming methods in class are not attractive, not interested or lacks in mathematics (Bennedsen, 2007) and also others factors (refer to figure 2).

The students suggested several approaches that may improvise their programming skills. The approaches are more technical training, more class room on lab training, more lab test and quizzes, upload videos tutorial on faculty/university website, study group with fellow classmate and meeting the lecturer individually as alternatives beside attending lecture and lab session that been scheduled by faculty in order to improve their skills.

![Figure 2: Factors that effects student interest in learning programming](image-url)

Figure 2 shows that of 51% students agreed to become a programmer and 43% choose programmer as career and only 5% undecided. The difference between the responses of marked yes and no were significant in many areas. In general, the students in major software engineering are seeing it as a career because of their major but for student’s which majoring in networking and multimedia, they are prefer others career such as technical engineer and designer instead of choose programmer as career, however these kind of careers are also needed programming skills.
B. Employer’s Expectation

Technical skills such as programming are important. However, employers expect that ICT graduates are equipped with non-technical skills as well. Non-technical skills are required in today’s job, though, given how articulate employers appear to be with teamwork. Communications play a part in almost every aspect of business. Good communication skills are essential to managing the performance of building a cohesive and effective teamwork.

One issue that was raised by industry experts is oral communication, mainly in English. This is one of the most common problems and identified as knowledge deficiencies. The ability to communicate with clients and possessing good listening skills was cited as specifies examples of how recent graduates did not meet expectations in this area (D. Hagan, 2004; Alex. R and Gursimran W., 2013). Software developer particularly fresh graduates often struggle with adequate communication when they were in need of assistance or struggling with a problem (Begel, et al., 2008).

This is in line with findings from an interview with an educator. Programming designed commonly using English language and the issues that need to be emphasized here is when some students are not able to communicate and understand English during lecture class. English is always being the first language to use for teaching in class. But, certain local students are weak in English communication and sometimes they are having difficulty to understand and capture the lesson in class. The educator pay extra attention to these students and always recall the earlier lesson in the next class. By mixing the English and Malay languages in next class as an alternative way used by lecturers for ensuring the local students have a better understanding of that particular lesson that been taught in the previous class.

"Students are from different regions, in first lecture class, I'll communicate and teach in English because international students only able to understand English. But, several of our local students are weak in English communication, due to this issue, in the next lecture class, I’ll recall the first lesson by mixed English and Malay to ensure these students have better understanding.”

Graduates also struggle with written communication, mainly in English as it an international language that is being used worldwide. As software developer, the ability to write and produce documentation (Byrne and Moore, 1997) is important when dealing with the clients and also teamwork.

C. Teaching Methods Recommended for Educators

To produce quality education, educators should be trained according to what is demanded by the industry. As educators are the major players of the change (Mumtaz et al., 2013). Many students reported that they are facing problems and are surprised on their first programming class, which are unknown to them. Summarizing the interviews with educators, here are some of the strategies that can be practice in order to improve teaching and learning that will produce quality graduates.

a) Know your students. It is recommended that lecturers familiarize with their students and tried to memorize student’s name.

b) Knowledge Quiz. Lecturers should give knowledge quiz to their students, quiz can vary according to the level of the students, this will enable the lecturers to identify and review the course contents.

c) Create Open Communication Concept. Encourage students to ask questions or seek assistance in class and lab. Engage with students by asking questions that test their concentration level during lecture class. Reward system can be implemented for students who are proactive in class. This will also create a progressive environment which students will immediately ask questions to get extra mark. Indeed, the answers provide the lecturer with vital information about the range of student’s knowledge and ongoing comprehensive. As this reason, this is important as lecturer to being approachable. The challenging assignments may require both advance planning and willingness to ask, creating interaction with many individual students may fosters a connection for future exchange after class or meet at lecturer’ office.
d) Create Positive First Impression among Students. Ask students about their ability, interest and difficult experience. A student’s first impression could be a negative perception. Hearing rumors from seniors or lack of interest in mathematics might distract their enthusiasm in learning programming. Often students create a thought of feelings such as “I’m not too in mathematics and it’s similar to programming”. This kind of perception can throw them into an emotional turmoil or fear of programming. Sometimes a problem can be addressed in group discussion or by talking about it, sometimes when a problem arise and students unable to solve through text books because they do not understand the flow and concept might put them in a difficult situation, by practicing an open communication concept these difficult situations can be eliminated earlier in the stage.

e) Engaging Learning. An engaging learning will be very helpful for novice undergraduates, regardless of class size, faculty and lecturers can take advantage through a variety of strategies to enhance students’ active engagement and promote more meaningful learning for example promoting program that are organized by faculty such as conference, talk, contest, exhibition, seminar and others related activities. The lecturers must be viewed as knowledgeable. While in university, the introductory of programming is the most crucial lesson as lecturer to ensure the students can build their interest. In programming, the fundamental of each programming subject is important to ensure students have clear understanding of the concepts and analogies, then it would be easy for them to explore and polish the skills by doing more practices and find out the related tips in programming. In improving the programming skills among undergraduates, the assuring quality teaching both lecture and lab session must be design and improvise well.

f) Lecture Class
The lecture class covered the introductory and theoretical part of the programming subjects. Learning in large lectures requires skills that many novice students in programming have not yet developed, such as active listening and tried to see the whole picture on how to program. It is a challenge for lecturers to ensure students have clear understanding on how to program, for example when to use variable, syntax and array by explanation on white board during lecture class. Because, the lecture setting can often be passive, and not interactive, these kinds of situation also can influence them. The strategies below can be used by emphasizing the structure of ideas in each lecture:

- communication in lectures with the students
- outline major points at the beginning of the lecture
- explicitly distinguish between generalization and examples.
- summarize periodically during each class and at the end of a lecture
- consider incorporating some interaction and discussion
- require students to write brief discussion questions or make earlier preparation before entering class
- ask more questions that require students to probe deeply into significance or implications of the course
- divide students into groups and give them tasks and develop a program as a group project at the end of each semester
- interactive and multimedia elements in teaching tools
- Multimedia elements can produce a new strategy in teaching introductory computer programming (Guzdial and Soloway, 2001). Lecturers can adopt the role of teaching with the use of interactive multimedia to attract students. The effect of using multimedia interactive tools on enhancing students learning have give a huge impact during lecture class, this response was admitted by anonymous lecturer, Database Structured subject. Students often pay attention and give positive feedback after watched an interactive video.

g) Lab Sessions
Lab sessions are on the other hand handled by IT trainers. Lab session provides each student a computer while trainer gives instruction on the board. During lab sessions, there are several ways can be implemented in order to improve student’s programming skills:

- concentrate to weaker students
- encourage group activities
- quality of assignment or project are similar to industry required
- assist students to develop greater awareness of their thinking strategies

D. Expand Internship Program Opportunities
The purpose of placements and internships not only seem to offer an effective applied method of developing appropriate skills, awareness and abilities in among undergraduates, but can also to promote productive collaboration and partnerships between universities and employers, indeed building greater understanding between the stakeholders. The importance of placements and internships has been recognized by policymakers and supported by funding. Therefore, the students who present good attitude and potential during the period on industry training will be absorbed to work with the company after graduating.

E. Continuous Updating Skills and Collaborative with Industry by Students

Employers reported a need to fill positions requiring specific programming skills most probably JAVA and C# languages. Besides standard syllabus in lecture and lab session, faculty also offer many programs for students to expose and sharpen their skills, for example 3P program during semester break. This program embarked on an industry-based certification initiative that is more relevant to industry needs. The purpose of this program is to bridge the knowledge gap between technology and skill sets in today's competitive job markets. This program offered to students and lecturers for intended their skills on specific languages including JAVA, PHP and Cisco.

Others similar program can be suggested for extended students skills such as practice new skills or upgrade the latest technology. In order to develop technical training programs, online and boot camp style, opportunities for current high-demand skills; Java, .NET, Agile development, cloud computing engineers, sales engineers, CRM and SharePoint. Boot camp and online training should be supplemented with student focused seminars to reinforce the skills learned.

VI FUTURE WORK

The scope of this research can be extended, for example comparing the teaching strategies that been practice in others universities. The experience in conducting this research can be set as a guideline to other researchers for them to extend on comparing the effectiveness each university practice their teaching styles to ensure the students have better understanding in learning programming. The data collection will be more accurate by giving two separate sets of questionnaires for undergraduates perceptions of the effectiveness of current teaching methods used to deliver the course contents and also the perceptions of the effectiveness of existing learning practices besides lecture and lab session.

VII CONCLUSION

The researcher believed that this research would be benefit to the academe within the education sector and also as references and guidance for management of universities and colleges in Malaysia in the formulation of appropriate strategies, plans and decision makings on its teaching and learning process for computer science courses. By enlist the solutions suggested in teaching programming skills in university will hopefully waved the issues of mismatch quality graduated that claimed by industry

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