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Need of Skill-Based Training in Computer Science Education

Srinivas Aluvala
Dept. of Computer Science and Engineering
SR Engineering College
Warangal, India
srinu_aluvala@yahoo.com

Nagendar Yamsani
Dept. of Computer Science and Engineering
SR Engineering College
Warangal, India
nagendar.yamsani@gmail.com

Abstract— Computer Science is one of the fast growing fields compared with many other undergraduate and post-graduate programs. Today, most of the educators in the field of computer science education and teaching have been in the approach of recommending redesigning the curriculum and restructuring the UG and PG studies of Computer Science according to skill-based training and learning approach. However, the issues related in defining the objectives and assess outcomes in this Skill-Based Approach (SBA) is challenging among the computer science teachers who are not basically trained in techniques for setting up objectives and evaluating the results. This paper serves as a brief introduction of SBA and how it can be practiced from the program design perspective. In this paper, my experience of initial attempt in designing and developing computer science studies using SBA will be shared. Based on the SBA paradigm, I evaluate teaching impact, effectiveness and student learning outcomes based on the teaching assessment results and their success. Through deeper understanding and learning, Skill-Based Approach education can bring a drastic change and will have a great impact on students and prepare them for both exciting career and successful lead in the computing world.

Keywords- *Skill-Based Approach; teaching evaluation; under graduate; post-graduate; computer science; curriculum;*

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I.   INTRODUCTION

This Skill-Based Approach education in the present day scenario has become a major focus in training and learning enhancement for many fields of education. From the past few years, some of the deemed universities and autonomous educational organizations have stressing the importance of emerging the skill-based framework in both design of curriculums and teaching pedagogy. Yet, the concept of Skill-Based Approach (SBA) teaching and learning can be traced back to an early stage of education evolution. Skill-based computer science education seems to be a new concept in the teaching and learning approach.

In the costumed way of imparting the computer science subject, both theoretical and practical contents are driven by the new and latest technology in industries day by day. A course of program in Computer Science studies about computer programming is all about teaching students what a computer programming language is, for example C, C++, JAVA, Dot Net, or any other programming language can do and perform. It is very rare to have a tight relationship with what a student is expected to gain at the end of degree. A question is that, should the educators simply impart the related topics to students so that the students know only how to write the programs of the curriculum. Or expect the students to be able to create a real time system with multiple commands? Perhaps the students can complete course with high grade or percentage of marks because of just simply knowing the commands, but not able to know how to manage set of commands to create a system of an executable program to get a solution for a specific task. Unless, in teaching and training of the student, the outcomes of the course and the program are presented precisely to the students, the entire course can become unworthy. And what is taught plays no meaning if a certain ability of students is not expected at the beginning and end. That is the reason; the "Skill-Based Approach" is to be brought into view and to be introduced to every educator, particularly in the field of computer science

engineering and computer applications at degree and PG level programs.

At our colleges, students usually come from different environments and academic backgrounds. Even with the enrolled students at our colleges in computer studies, no prerequisite requirements are expected. Students who already studied computer science at any level should be again trained and taught from the basics, so as to prepare them for higher studies. At the same time when our degree and PG programs targets on industrial oriented approach, the method of teaching and learning needs to have precise objectives both for the teachers and students. To guarantee that students achieve certain skills. At the degree and PG level computer science programs curriculum design needs to be as specific as possible so that the objectives of the program are reached. With this approach of Skill –Based Approach it could be easier to reach out the objectives and lead in the development of interdisciplinary courses of computer science engineering and applications.

II.   MOTIVES

First, in computer science engineering or in general studies of computer applications, SBA did not exist till now in curriculums. SBA is a teaching and learning methodology which focuses on what students are expected to learn and how it becomes measurable through assessment.

At the inception two major tasks are the vital components in this SBT (skill based training) of SBA. The first focuses on what students will be expected to be able to do after completing the course of a program. In curriculum design of the program, a set of outcomes are required to be mapped to all the courses under the program. After knowing what the curriculum expects, next is to focus on the preparation of the learning outcomes. Bloom's taxonomy of the cognitive domain frame work is widely used in the design and assessment of courses. Yet, this system is found not suitable in computer science engineering education. Because of different reasons compared with other fields of education.

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Once it is over, the next important task is to state how the students will learn it, or the teaching and learning activities, which leads to the assessment procedures as managing learning outcomes. The assessment using SBA can offer some meaningful feedback to the teachers regarding student's achievement, achievement and the quality of the instruction.

Surprisingly today most of the teachers follow time saving normal referenced assessment. Students were also encouraged to perform traditional learning methods; most of the teachers in teaching computer science may not adopt this SBA. The effectiveness of this approach may not be known at the moment of usage. Despite of the immaturity of SBA, a promising future is shortly to be realized. I strongly believe that it is a true education when the teachers turn teaching to a student centric approach imparting more skills in the fields.

III.   SKILL-BASED APPROACH CURRICULUM

A.   SBA Framework

SBA is an approach to design curriculum where teaching and learning mainly focus on the expectation of students after their completion of the degree, what they are expected to do, rather than what the teacher expects to teach. The objective of curriculum is shifted to the student centric approach, under the SBA framework, the assessment leads to a Criteria Referenced Assessment (CRA) based practically instead of normal referenced assessment. CRA concentrates on the expectation of students learning skills they should have to obtain a degree.

B.   SBA Curriculum Design Example

Engineering or any PG program in computer science is to be designed as a job oriented approach so that students are expected to learn skills which are essential to their future jobs.

For example if a student wants to become a software developer they should be able to write programs for the real time problems using different programming languages at the end of completion of the degree. For any program at the beginning it should clearly specify the learning outcomes and objectives of the program. For example:

i) Focus on Objectives: Any degree in computer science program to be designed to meet the following.

- To incept and develop student's ability in programming, designing systems and developing logics.
- Provide an environment to increase student's capability and confidence for independent thought and creativity.

ii) Objectives of curriculum are:

- Provide students with the knowledge and techniques to effectively design and manage software and hardware projects, and to be able to aim a career in related field.
- Students need to undergo a professional training so that they may acquire the ability to adapt to different development working environments in the industry.
- Provide students with the sound basic knowledge with logical thinking for further technical and career development and qualification to enable them to go for higher qualifications, locally or abroad.
- Promote students capabilities in communications, social awareness and moral responsibilities. In addition, to this there are more objectives that are relevant, a graduate or a postgraduate should acquire knowledge and skills in

computer programming, networking, security, operations and management.

iii) Course Components:

Sound fundamental, programming concepts, elementary data structures, design and analysis of algorithm, systems analysis, software development process, information management and discrete mathematics to be taught. With the introduction of all the key basic building blocks should be imported at the inception of every course study, along with emphasis shifting from fundamentals to a professional perspective and to industry standards. Software development and management is to be taught in order to introduce students to development life circle, and all so be trained to document the design and coding.

In course of program students need to study more advance units of programming, software development concepts and techniques. At the end of the course, students should acquire software techniques for developing network applications and data base systems. Advanced subjects such as artificial intelligence systems, object-oriented analysis and design, advanced pattern matching and human computer interface are intended to strengthen students in logical programming techniques.

Prior to acquiring graduation or post graduation degree, students need to be assigned with two or more projects to gauge the overall culmination of knowledge of programming , understanding, and technical skills that they have acquired during the course study of a program. At end students should be capable of analyzing, design, code, test, and document and present a software project with their level of competence and to industry standard.

iv) Teaching & Learning Activities:

During the course of a program, I emphasize that lectures, seminars, guest talks, case studies and projects need to be provided to students so that they are bestowed with the opportunities to learn from real time examples. This helps them to practice on their own and develop working software applications. Students need to be encouraged to think independently and apply their thoughts in accomplishing specific real time problems. To achieve this, students need to be encouraged to adopt and active knowledge seeking attitude and to increase and strengthen their own confidence and ability to communicate and work with the team.

Based on the nature of the subjects, all or some of the different training and learning approaches like lectures, tutorials, seminars, guest talks, industry experts interaction, case studies and project developing exercises can be employed. During this students will be encouraged to raise queries on the subject matter and participates in short discussions. Lectures are to introduce and explain concepts, demonstrate how to illustrate and analyze an issue. Develop student's capability to think independently. Case study (i.e. the case analysis of an application) enables the students to examine, analyze and solve problems of the real world and practical problems of the industry. Guest talks and industry experts may be invited to interact with the students to share their up-to date technical knowledge. Students are encouraged and well supported to carry out self projects and team works to apply the knowledge they gained from the learning process. Problem solving skills are developed by applying a range of techniques and ideas in handing real world problems. All the above training and

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learning approaches will create a learning environment in which students play an active vital role.

C. Courses and Program Assessment System

At program level, the SBA suggests that all the course learning out comes should point to the objective outcomes of the course of a program. At this level the difficulties may be facing is whether the program learning outcomes can be met by all the courses of a specific program. Basic idea is to make use of system application software called Program and Courses Outcomes System (PACOS) developed by a group of research students at the Hong Kong University of Science and Technology. It is a free open source web based system; it was designed to access and amend course result mappings of the programs.

IV. LEARNING OUTCOMES AND MEASUREMENTS

The objective in SBA training and learning is to transfer the paradigm from teachers centered approach to student centered approach. That means, learning outcomes are to reflect what students are expected to gain and able to do at the end of the course of a program.

The technique of bringing out the effective learning outcomes depends on the right verbs used in the statements; Bloom's taxonomy is commonly used for defining learning outcomes, which give the benefits of its ready-made structure and list of verbs. The verbs in Blooms taxonomy are measurable. For example, one of the learning outcomes in a course can be, "Upon the completion of the course, students should be able to develop a group project of a real time application system". A good quality assessment activity can be to a group project approach. If a group of students can work together to develop a system, then we can confirm that the students have achieved the one of the learning outcomes. Further, individual evaluations can confirm if each of the students have made an appropriate contribution to the project.

A poor example of learning outcomes can be, "Upon the completion of the course, students will be able to know only the commands of a programming language, when can be used for the developing of the system. In such case, the student assessment is difficult to measure. In other words, the understanding of knowledge cannot be reflected by any mean as a student can simply respond with a feedback at the end.

Table I

Knowledge-Based Systems (Bloom's Taxonomy).

Aims	Learning Outcomes
Create	Compose, construct.
Evaluate	Prioritize, justify.
Analyze	Identify, categorize.
Apply	Use, solve.
Understand	Predict, outline.
Remember	Write, tell, list.

V. CONCLUSION

It creates a better training and learning and environment where all the activities can reflect the worthiness of the skills the students acquired. Assessment of the training and learning outcomes becomes very precise, because students know what they need to learn and do upon the completion of the degree. Students feel their progress in developing intellectual skills through the course as the outcomes and objectives are clearly stated in the course syllabus. It offers an intuition that the skill-based approach framework can enhance teaching and learning in overall performance among the program of study.

SBA is indeed going to be a promising direction in our education system such that student outcomes are to become a driving force and motivation of teaching and learning. I believe that our students will continue to be trained and become potential future leaders of the industry.

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