

Application-based Effective Curriculum Design and Development for Employability

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Abstract

Employability is becoming a major objective of education today. Every institution is striving to make their students employable. This paper mainly focuses on the theme of outcome-based education's "effective curriculum design and development" and its present significance. We propose to have a fine blend of Fundamentals and factors in the curriculum design. Considering these factors of the novel approach, a model employability curriculum has been proposed and compared. A case study on the software testing course has been applied and a new curriculum design presented. The proposed methodology is anticipated to bring major changes in meeting the expectations of professional courses. The proposed work has been carried out by taking a sample syllabus or curriculum copy of a university for a better understanding of the work as well as easy identification of the parameters of the curriculum. There is a very critical aspect of the fact that most graduates coming from colleges and universities are not readily employable. Thus, the employability factor plays a critical role in framing the university syllabus or curriculum. It is an honest effort to bring a new change in the design and development of the curriculum.

Keywords: Employability curriculum, curriculum design and development, software testing, employability factor, fundamental factors

INTRODUCTION

The term 'employability' refers to a student's ability to acquire expert knowledge and the skill to apply it in real-world situations. It can also be defined as "practical intelligence." The present curriculum design provides more knowledge based on its applicability [1]. Students are encouraged to study basic, elementary, and futile information about specific disciplines or fields. Rather, the real world expects the application of knowledge, innovation in the present form, and the development of new methods. This affects economic downfall, employability, and social conditions [2].

Employability skills, also known as soft skills, are a set of skills and personal attributes valued by employers and common to all work roles. Examples of employability skills include [3, 4]:

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- *Communication:* The ability to communicate effectively with others in multiple formats.
- *Planning and organizing:* The ability to schedule workflow, plan resources, manage one's own time, multi-task, and meet objectives.
- *Leadership:* The ability to motivate, influence, and guide others.
- *Self-management:* The ability to accept responsibility, be resilient, and appropriately assertive.

- *Resource management*: The skill of effectively managing time and other resources.
- *Information utilization*: The capability to comprehend, assess, and apply various types of information.
- *Systems thinking*: The ability to recognize and understand the connections between different parts of a system.
- *Technology use*: The ability to apply information technology appropriately and effectively.

CURRICULUM DESIGN FACTORS

Figure 1 shows the factors identified and proposed for effective curriculum development, including their outcomes in universal productivity [5, 6]. Namely (1) fundamental factors, (2) employability factors, and (3) case-control studies [7]. These identified factors provide insight to students for studying any course with clarity along with its purpose, objectives, and outcome. This will help students to co-relate and apply these concepts in the near future [8].

Curriculum

The curriculum contains the totality of students' experiences in a particular course. In this article, we are considering the "software testing" course as a case study to illustrate the effectiveness of curricular design and development for the effective employability parameter [9, 10].

Figure 2 provides the typical and general factors that are considered, along with drivers and constraints in curriculum development.

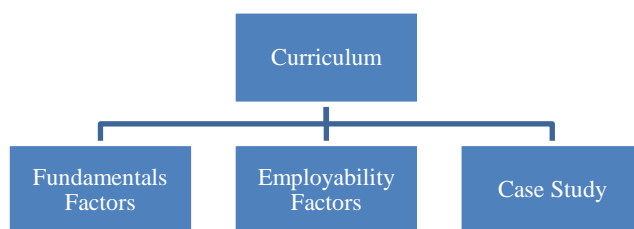


Figure 1. Employability curriculum.

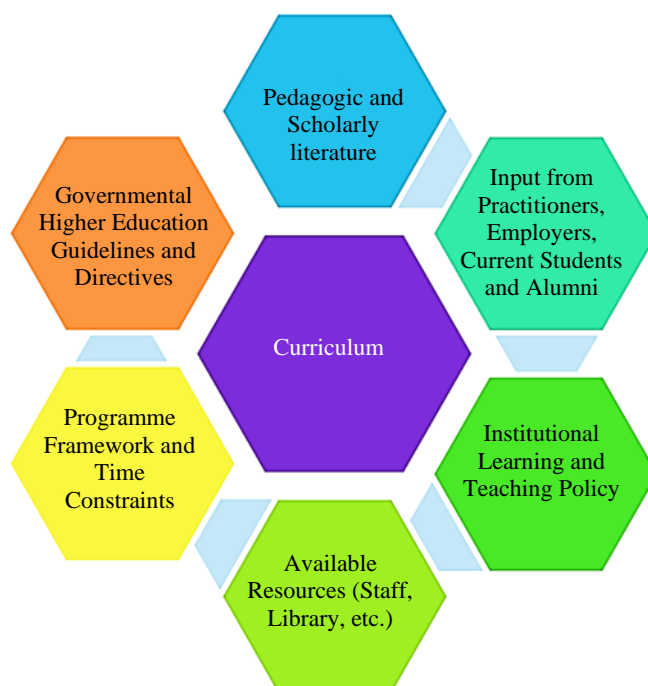


Figure 2. Drivers and constraints in curriculum development.

Considering the sample modules of the Introduction to Software Testing course for our analysis and expression of the proposed in education, a curriculum is the totality of student experiences that occur in an educational process [11, 12]. The term typically refers to a structured sequence of lessons or the student’s learning experiences as viewed through the lens of the educator’s or school’s instructional objectives, as shown in Figure 3 [13].

Syllabus for INTRODUCTION TO SOFTWARE TESTING
 Fifth semester Computer Science and Engineering

Sub. Code	17C5552	IA Marks	40
40	3 Hours	Exam Marks	60
Module 1			10 Hours
Basics of Software Testing: Basic definitions, Software Quality Requirements, Behaviour and Correctness, Correctness versus Reliability, Testing and Debugging, Test cases, Insights from a Venn diagram, Identifying test cases, Test-generation Strategies, Test Metrics, Error and fault taxonomies. Levels of testing, Testing and Verification, Static Testing.			
Textbook 3: Ch 1:1.2 1.5, 3; Textbook 1: Ch 1			
Module 2			10 Hours
Problem Statements: Generalized pseudo code, the triangle problem, the NextDate function, the commission problem, the SATM (Simple Automatic Teller Machine) problem, the currency converter, Saturn windshield wiper Functional Testing: Boundary value analysis, Robustness testing, Worst-case testing, Robust Worst testing for triangle problem, NextDate problem and commission problem, Equivalence classes, Equivalence test cases for the triangle problem, NextDate function, and the commission problem, Guidelines and observations, Decision tables, Test cases for the triangle problem, NextDate function, and the commission problem, Guidelines and observations.			
Textbook 1: Ch 2, 5, 6 and 7, Textbook 2: Ch 3			
Module 3			10 Hours
Fault Based Testing: Overview, Assumptions in fault based testing, Mutation analysis, Fault-based adequacy criteria, Variations on mutation analysis. Structural Testing: Overview, Statement testing, Branch testing, Condition testing, Path testing: DD paths, Test coverage metrics, Basis path testing, guidelines and observations, Data -Flow testing: Definition-Use testing, Slicebased testing, Guidelines and observations.			
T2: Chapter 16, 12 T1: Chapter 9 and 10			
Module 4			10 Hours
Test Execution: Overview of test execution, from test case specification to test cases, Scaffolding, Generic versus specific scaffolding, Test oracles, Self-checks as oracles, Capture and replay Process Framework Basic principles: Sensitivity, redundancy, restriction, partition, visibility, Feedback, the quality process. Planning and monitoring, Quality goals, Dependability properties Analysis Testing, Improving the process, Organizational factors. Planning and Monitoring the Process: Quality and process, Test and analysis strategies and plans, Risk planning, monitoring the process, Improving the process, the quality team.			
T2: Chapter 17, 20.			
Module 5			10 Hours
Integration and Component-Based Software Testing: Overview, Integration testing strategies, Testing components and assemblies. System, Acceptance and Regression Testing: Overview, System testing, Acceptance testing. Usability, Regression testing, Regression test selection techniques, Test case prioritization and selective execution. Levels of Testing, Integration Testing: Traditional view of testing levels, Alternative life-cycle models, The SATM system, Separating integration and system testing. A closer look at the SATM system, Decomposition-based, call graph-based, Path-based integrations.			
T2: Chapter 21 and 22, T1 Chapter 12 and 13			

Figure 3. Sample modules of the course introduction.

Fundamental Factors

These factors provide the basic and evolutionary knowledge of the course. The proposed concept should not be elaborated on, but it is required proportionately to ensure that the students get elementary knowledge/information, as shown in Table 1 [14–18].

- Basics of the domain or field
- Concepts of the course
- Legacy information
- Precedent developments
- Evolutionary knowledge

Employability Factors

Employability factors ensure students' skill sets in their workplace [19]. The desirable qualities that employers accept from freshers, such as attitude, communication, lead work, self-management, lifelong learning, problem-solving, and so on, are considered in the following factors, as shown in Table 2 [20].

- Focus on applications
- Usages of tools
- Production knowledge
- Improve productivity
- Case study and analysis
- Industry savvy

Case Study

Case studies help students in exploratory research, generate new ideas, and contribute fresh thinking toward development from previous studies, as shown in Table 3 [21].

- Illustrative
- Critical

Table 1. Fundamental factors.

Parameters	Curriculum	Employability curriculum
Basics of the domain or field	Present	Present
Concepts of the course	Present	Present
Legacy information	Present	Not present
Precedent developments	Present	Not present
Evolutionary knowledge	Present	Not present

Table 2. Employability factors.

Parameters	Curriculum	Employability curriculum
Focus on applications	Not present	Present
Usages of tools	Present	Present
Production knowledge	Not present	Present
Improve productivity	Not present	Present
Case study and analysis	Present	Present
Industry savvy	Not present	Present

Table 3. Case study factors.

Parameters	Curriculum	Employability curriculum
Illustrative	Not present	Present
Critical	Not present	Present

Table 4. Confrontation of software testing course curriculum.

Factors	Curriculum	Employability curriculum
Fundamental factors	Basics of the domain or field Concepts of the course	Basic testing vocabulary Software quality factors Testing constraints Life cycle testing Levels of testing
Employability factors	Focus on applications Usage of tools Production knowledge Improve productivity Case study and analysis Industry savvy	[Selenium/QTP/load runner/etc.] Test planning Budgeting and scheduling Build the test plan Write the test plan Test execution Test reporting Defect management Test Coverage—traceability matrix
Case study	Illustrative Critical	<i>Industry:</i> eCommerce Retail Financial <i>Product:</i> CRM system Social networking Web portal <i>Technology:</i> GUI testing Automation testing

Employability Curriculum

The employability curriculum equips students with essential skills, knowledge, and strategies to succeed in today’s competitive job market and smooth transition from education to employment, as shown in Table 4 [22].

CONCLUSIONS

The employment curriculum focuses mainly on industry inclinations and employment. In this paper, the existing software testing curriculum is thoroughly analyzed and studied based on various proposed parameters, and an employability curriculum has been proposed to match/fill the gap between the present market and the present curriculum. In addition, the authors wish to propose a periodic review of the courses, based on the recommendations of the stakeholders of society and the government.

The prime focus of employability curriculum design and development is to prepare industry-ready engineers rather than updating the latest knowledge after graduating. It is proposed to include such topics as industry and industry-oriented topics/courses, which build students’ readiness for their careers. This approach also helps academicians and researchers look into the present state of technologies and helps bring innovation and research from the current level of industry.

Employability is a vital skill for career progression and maintenance. To remain competitive in a global and evolving job market, individuals need to continually update their employability skills. Research from 15 sources shows that employers prioritize skills such as communication, teamwork, problem-solving, and technological know-how. In today’s disruptive era and the future, key skills are categorized into cognitive, basic, and cross-functional skills. However, future demand predominantly emphasizes soft skills and technological capabilities. Therefore, the education system needs to incorporate these employability skills into all learning processes.

Employability is an essential skill for individuals to continue advancing and sustaining their careers. To compete globally and adapt to future job markets, individuals must continually update their

employability. According to a study analyzing 15 sources, employers identify key employability skills, such as communication, teamwork, problem-solving, and technological proficiency, as essential for workers. The skills most relevant to the current era of disruption and the future fall into three main categories: cognitive abilities, basic skills, and cross-functional skills. However, soft skills and technological expertise are expected to dominate future skill requirements. Given the importance of employability, the education system needs to incorporate them into every aspect of the learning process. A country like India, which has a very large population and versatility, requires the inclusion of the employability factor as an impact factor index for any curriculum development.

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