The novel evaluation scheme for Competency Based Learning, authentic assessment and its implementation strategies for universities of higher education

Sampath Kumar V, Veerendra Kumar A N, Sanjiba Kumar Bisoyi and J P Pandey
ECE Department, JSS Academy of Technical Education, Noida, Uttar Pradesh, India.
Address: C-20/1, Sector-62, Noida

Abstract—**Competency based education and its continuous assessment creates a strong interest amongst all stakeholders involved in the laboratories. The initiatives in this paper are proposed to strengthen affiliating technical university curriculum in true spirit to adopt outcome-based (OBE) education practices at all levels of courses. These initiatives shall complement and supplement the Government of India initiative National Education Policy 2020 (NEP 2020) implementation. The main beneficiaries of this proposed work will be the students and faculty among important stakeholders. The initiatives proposed will help to ease the problems of identifying proper learning materials, identification of course pre-requisites, and for the effective Industry Academia Connect for better development of employable graduates with Industry required attributes and skills. Also, to ensure highest standards of Teaching -Learning experience which will lead towards academic excellence, ensures to become an active participant in their learning process. Pre-requisite courses to be mentioned for all courses. In Structure of the syllabus, periods can be modified to L T P C (Lecture Tutorial Practical Competency) components.**

Keywords—**Competency Based Learning (CBL); Competency Based Evaluation Scheme (CBES); Outcome Based Education (OBE); Student Assessment Management (SAM).**

I. INTRODUCTION

The value of effective student learning outcomes, for faculty point of view, are the content of teaching, teaching strategies, the sorts of learning activities/tasks set for students, appropriate assessment tasks and course evaluation. In students' point of view, it informs the comparative effectiveness of cognitive skills, a solid framework to guide their studies and assist them to prepare for their assessment, the higher order skills opportunities, Knowledge Development, Skills Development, Attitudinal Change and Values Change.

Linking Student learning outcomes to competencies is challenging and also provides opportunity for individual overall development. Competencies are obtained or developed during the process of learning by the student/learner. Competencies actually represent a dynamic combination of knowledge, understanding, skills and abilities. Fostering competencies is the objective of educational programs developed in the university system. Competencies will be formed in various course units and assessed at different stages of teaching – learning process. Time and attention should also be devoted to the development of generic competences or transferable skills.

Types of generic competencies are as follows

1. Instrumental competences are cognitive abilities, methodological abilities, technological abilities and linguistic abilities;
2. Interpersonal competences are individual abilities like social skills (social interaction and co-operation);
3. Systemic competences are abilities and skills concerning whole systems (combination of understanding, sensibility and knowledge; prior acquisition of instrumental and interpersonal competences required).

Everyone has the capacity to learn, it simply happens at a different rate and maybe in different ways for each one of us. They are assessed right exactly when they are confident to demonstrate their competencies. Competency based learning or knowledge-based training is a massive reformation from traditional time-based learning to learning-based learning.

Competency component assessed with the below mentioned items

1. Task Skills - Performing individual tasks.
2. Task Management Skills- Managing a range of different tasks.
3. Contingency Management Skills - Responding to contingencies or breakdowns.
4. Team/role Environment Skills - Dealing with the responsibilities of the workplace, including working with others.

Competency based learning is heterogeneous approach to teaching, learning, curriculum, and assessment and is effective to all higher education today.

II. LITERATURE SURVEY

The curriculum refers to learning opportunities and learning experiences provided and planned by a university system to learners as mentioned in (Print,1993). In (Wojtczak, 2002) mentioned that description of curriculum with the technical approach describing that curriculum comprise the lesson plans, including learning objectives to be achieved, the topics to be

discussed, and the methods to be adopted for teaching, learning and assessment. In view of these curriculum will help to master and demonstrate skills, provides opportunities with relevant required resources to mastery the concept and excel in particular domain. This indicates, curriculum evaluation scheme and its assessment components play a vital role in the growth of Individual during the journey of education. These components need to be flexible in nature as one expert cannot assess all the learning competencies. Hence there is a need to involve subject matter experts' team for the assessment of these competencies from an Academia, Industry and Start-up/Incubation ecosystem.

In (Cheryl & Michelle,2021), work mainly focuses that assessment experts in education system must provide strong opportunities to support and assess the progressive, lifelong development of relevant knowledge and skills. Here one of the challenges highlighted that is the lack of instructional guidance specific to a competency-based approach. This has been addressed in this paper with the help of SAM process model.

In (Gullickson & King, 2019; JM & Clinton, 2019), analysis suggests that there is much work to be done to understand the needs for evaluation and assessment, to outline standards for quality in both teaching-learning process and practice, to identify the inputs and processes most effective for addressing those needs, and to document its ultimate impacts. These challenges have been exploited and addressed in the proposed model at two levels.

In a competency-based curriculum (Griffith & Lim, 2014), students are rewarded only for successful completion of authentic tasks. both students and teachers need to step out of their comfort zones and adopt new roles for successful and effective implementation. As these paper authors explains the success of this process is depends on new roles and process used. Hence, continuous assessment and CBES structure will help to identify individual progress at any time.

Large number of students still struggle to graduate on time within traditional systems because of accessibility and availability of resources outside university campuses. Hence higher education systems are shifting their focus to ensure curriculum and employment readiness is a realistic and attainable aim for all students. In this work (Blumenthal & Rasmussen, 2015), opportunity for CBE model and one novel model to support university system for utilizing the benefits of CBE has been demonstrated.

The initiative to introduce the CBES into higher education university system curriculum will give a new momentum, opportunity to foster the creative potential & new direction that curriculum should provide for the students for continuous learning and their ability to cope with ongoing educational requirements.

III. PROPOSED MODEL

There is a need for new approaches of learning management in education for providing more personalized learning experiences, while ensuring that every student has a strong foundation in the STEM concepts, skills and competencies required to succeed in the 21st century (Jose Ramon & Yolanda, 2018).

In CBES, curriculum needs to be designed by considering objective-based and self-paced learning approaches. Students learn based on their abilities and interests. Hence, teachers should provide individualized support to ensure deep learning. Further, students' assessment (Goldie, Andrew & Utkarsh, 2016) is done through demonstration of knowledge, skill and competency acquired. Students will progress through grades based on demonstrated competency in particular subject of assessment. Through this CBES, students are benefitted with the flexibility to learn according to their preferred style, at their preferred time and on their favourite device (Osama, 2021).

The Fig.1 provides the proposed CBES structure for developing syllabus for complete graduation or post-graduation programs. The Fig.2 elaborates components used for teaching-learning process (U.P. Kulkarni & Indira R. Umarji, 2017) and number of periods per course. These components provide opportunity for students to learn any course either through regular practical's or by demonstrating course competencies through their preferred time and style. Fig.3 shows the Assessment Components used in CBES for both internal & external assessment (Maruti, Anandrao & M. S.Patil, 2018).

The student assessment management (SAM) process is proposed to assess each student for each course by the teacher using proposed four categories. They are Direct Tools, Indirect Tools, Certifications obtained and Amount spent per student. Each category is assessed in a scale of 10. The assessment components will provide progress indication that how student is acquiring competencies in each category. For example, to acquire a mastery through demonstration of skills by implementing any project or prototype or case study with data analysis requires a budgetary provision to create a resource required and for recurring expenditure. Hence amount spent per student during their study period will fetch score in a scale of 10. Similarly, the Fig.4 shows the details of assessment components and total score of each student. Fig.5 & Fig.6 shows how each main assessment component is further assessed for each subject student is studying. All assessments are shown in this paper is in a scale of 10.

CT	Calss Test
TA	Teacher Assessment
PA	Practical Assessment
CA	Comptency Assessment
TE	Theory End Semester
PE	Practical End Semester
CE	Comptency End Semester

Fig. 3. Proposed Evaluation Scheme Structure

This SAM process has been implemented in one semester to observe student progress by considering sample size of 300 students and Six subjects. In each subject, assessment is done

by the team of faculty, lab staff and Industry or Start-up/Incubation expert (Balasubramani, 2019).

Benefits:
1. Student work on their own identified problem and project with required resources.
2. Flexibility and opportunity to gain real-world experience.
3. Personalized way of teaching and timely support.
4. Recognition of prior learning.
5. A novelty in assessment and grading (Tamer & Christopher, 2017).
6. A different strategy for communication progress.
7. A skill-based training program that ensures quality.

Fig. 5. Proposed Evaluation Scheme Structure Assessment Components -I

Fig. 6. Proposed Evaluation Scheme Structure Assessment Components -II

TABLE I
ACADEMIC PERFORMANCE INDEX OF CBES STUDENTS

Section	N	Mean	Standard Deviation	P-Value
Section 1	60	7.78	0.41	0.08
Section -2	60	7.86	0.27	0.07
Section-3	60	8.23	0.15	0.05
Section-4	60	8.29	0.13	0.04
Section-5	60	8.33	0.11	0.02
AVG	60	8.09	0.21	0.05

TABLE II
SUCCESS INDEX OF CBES STUDENTS

Section	N	Mean	Standard Deviation	P-Value
Section 1	60	0.91	0.013	0.1
Section -2	60	0.94	0.026	0.07
Section-3	60	0.95	0.006	0.08
Section-4	60	0.93	0.005	0.1
Section-5	60	0.96	0.006	0.1
AVG	60	0.938	0.011	0.10

Fig. 4. Proposed Evaluation Scheme Structure

IV. RESULTS AND DISCUSSION

The results obtained for the Five Academic Years have been Tabulated in Table I and Table II for Academic Performance index and Success Index (R Senthil, 2020) respectively. Inputs are considered from two Engineering Programs with the data set of 300 students. Mean values around 80 percent and standard deviation below 0.21. P-value is compared with null hypothesis of 100 percent achievement. P -value is greater than 0.05 for all the sections.

V. CONCLUSION

The proposed CBES structure model and SAM process assessment results shows the enhancement of higher order level competencies, soft skills and quality. Practice of CBES model and SAM process assessment contributed in enhancing academic performance index around 90 percent & Success Index around 94 percent. These models have contributed in the enhancement of Teaching-Learning process of CBES curriculum and its assessment of competencies. Further, the proposed models in this paper can be enhanced and strengthened by tracking individual students learning styles and individual competencies. The SAM process has a greater number of assessment components and different abstraction levels, hence practicing this proposed process for 2 to 3 academic years will give deep insights and benefits along with observable outcomes. Revision of learning outcomes and considering type of Assessment, Competencies, Pedagogical Strategy, Budget and Infrastructure are main challenges of the proposed work.

ACKNOWLEDGMENT

REFERENCES

Andrzej Wojtczak (2002) Medical education terminology, Medical Teacher, 24:4, 357, DOI: 10.1080/01421590220145699.

Print, Murray. (1993). Curriculum development and design. St. Leonards, NSW, Australia: Allen & Unwin.

Poth, C. (2021, March 22). Competency-Based Evaluation Education: Four Essential Things to Know and Do | Canadian Journal of Program Evaluation.

Gullickson, A. M., King, J. A., LaVelle, J. M., & Clinton, J. M. (2019). The current state of evaluator education: A situation analysis and call to action. Evaluation and Program Planning, 75, 20-30. https://doi.org/10.1016/j.evalprogplan.2019.02.012.

Journal, M. (n.d.). *MEXTESOL Journal.* http://www.mextesol.net/journal/index.php?page=journal

Blumenthal, D., & Rasmussen, J. (2015) State approaches to competency-based education to support college and Career Readiness for all students. American Institutes for Research. (n.d.).

Tamer El-Maaddawy and Christopher Deneen (2017), "Outcomes-Based Assessment and Learning: Trialling Change in a Postgraduate Civil Engineering Course", pp.1-18, Vol.14, Issue-1, Article -10, Journal of University Teaching & Learning Practice.

Jose Ramon Morales-Avalos, & Yolanda Heredia-Escorza. (2018). Igniting the Innovation's Competencies at Engineering Schools: IoT to the Cloud Labs Network in Mexico", pp.159-167, Vol.8, No.2, World Journal of Education.

Goldie Gabrani , Andrew Solomon and Utkarsh Dviwedi. (2016) , Teaching Pedagogies Used in Higher Education for Better Learning Outcomes, Vol.30, No.2,Journal of Engineering Education Transformations.

Osama H. S. Hassanein. (2021) Investigating Competency-Based Learning Implementation at the Northern Border University (NBU): A Descriptive Analytical Study, Arab World English Journal (AWEJ), pp.3-21Volume 12.

U.P.Kulkarni ,S.B.Kulkarni ,K.C.Shindhe and Indira R.Umarji. (2017). Validating Attainment of Outcomes Through Exit Surveys - A Case Study, pp.11-15, Vol.31, No.2, Journal of Engineering Education Transformations, October 2017.

Maruti R Jadhav, Anandrao B. Kakade,and M. S.Patil. (2018), ICT and Active Teaching-Learning-Assessment Process in the Engineering Education",pp.58-62,Vol.31, No.3,Journal of Engineering Education Transformations.

Balasubramani R,"Participation of Industry in Curriculum Design and Development. pp.56-60, Vol.33, No.1, Journal of Engineering Education Transformations, July 2019.

R Senthil. (2020). Enhancement of Engineering Education by Incorporating Active Learning Methodologies, pp.12-20, Vol.34, No.1, Journal of Engineering Education Transformations.