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Indirect Assessment of Outcomes in Education: A-Review

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***Abstract*—** Outcome Based Education (OBE) is the focal point of teaching and learning methodology. To achieve OBE many components are essential like Programme Educational Objectives (PEOs), Exit Outcomes (EOs), Programme Outcomes (POs), Course Outcomes (COs), Graduate Attributes, Lesson Outcomes, Unit Outcomes, Vision and Mission. Attainment of any of these components lead to the achievement of OBE and validate the teaching- learning process.

Modes of Outcome Based Assessment can be direct (tests, assignments, projects, end examinations, formatives) as well as indirect (feedback, discussion forums, blogs). Much work has been done to check the attainment of outcomes and achievement of OBE using the direct assessment tools. This study focuses on the development of a systematic approach to check the achievement of OBE using automated indirect assessment tool. Traditional way of assessing the attainment of outcomes is not optimal. As to manually calculate the attainment from the huge datasets requires much effort. Hence, automated process of indirect assessment of outcomes has become the necessity in today's era.

***Keywords*—** outcome based assessment, programme outcomes; course outcomes; outcome based education; survey tool, indirect assessment.

I. INTRODUCTION

Outcome Based Education (OBE) is used to access the attainment of competent skills developed in the students by virtue of going through the learning process. It is even used by many accrediting institutions. OBE inculcation helps to improve the course content and learning outcomes to enhance the efficiency of teaching and learning process [1]. Deciding student's fulfillment and achievement level is the key basic segment in the end circle of the learning procedure inside the setting of OBE. Student-centric approach of teaching and learning is required to accomplish OBE. Before the teacher-centered approach was utilized as a part of teaching-learning, in which, fundamentally the course substance and learning process is instructor driven. The evaluation and the relative effect are investigated by keeping the teacher's view as the driven viewpoint. Be that as it may, today the assessment is done on the premise of what the student is planned to learn after the culmination of the course. Student's fulfillment level, desires and learning conduct proves the critical part in the displaying of the course achievement rate. This student-centric approach is fundamentally known as OBE. Another essential viewpoint in OBE is quality assurance alluded to as CQI (Continues Quality Improvement) [2]. CQI helps to address the problem of skill set mismatching. It is where an instruction program is persistently, methodically and deliberately enhanced in a procedure or cycle where the positively increasing outcomes are processed. Most of the colleges have embraced CQI to enhance their instructing and learning process.

Kasunic [3] states that Survey has a critical use in associations like giving precise input, aiding critical thinking, giving consistency in the outcomes, supporting compelling decision making and considerably more. Yet, essentially applying any conventional method of surveying can prompt different disadvantages. LimeSurvey and Survey Monkey are the two noteworthy survey designing tools. Survey designing tools ought to be chosen by considering different parameters like convenience, timeliness, response rate and other basic execution measures. Trade off can happen among different parameters related with the effective survey designing tools. That parameter which is estimated to be more beneficial than other should be opted. The cost viability of web reviews have keep on driving towards the pattern of Web Surveys and additionally these are turned out to be a valuable resource in the period of innovation, where headway is the key criteria of progress [3].

This study helps in the development of an automatic approach for the assessment of outcomes. Thus reducing the manual efforts required to compute the attainment status of outcomes. Teachers can utilize their time and efforts on the

efficient skill development of students and improve the performance of low performing courses.

Rest of the paper includes Section II defining the Key essential concepts in Outcome Based Education, Section III comprises of Recent trends in the educational activities and section IV comprises of Conclusion along with the Future work.

II. KEY ESSENTIAL CONCEPTS IN OBE

A. Programme Outcomes

Program Outcomes (POs) depict the expansive articulations of graduates' skills, knowledge, efficiencies and ability that fill in as the measure of accomplishment of the goals of Program Educational Objectives (PEOs). The POs are mapped according to the rules given by Engineering Council with those that are required by the Engineering Accreditation Council (EAC) [4]. Crafted by Bloom in 1956 had built up a few scientific classifications', later on these scientific categorizations were set as the benchmarks. Bloom's work portrays the imperative facts which are valuable in the assessment of OBE. Bloom's working gives us the six progressive levels organized in the hierarchy as appeared in the fig 1.1.

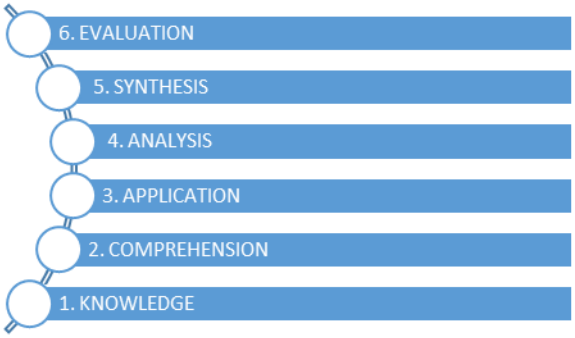

Figure 1.1: Six increasingly complex levels of our thinking proposed by Bloom

Bloom furnishes us with the six levels of thinking. In this, the ability of the student to perform on every individual level relies on the ability of the student to perform on the levels present beneath in the progressive system. This moves us to OBE accomplishment by giving us the helpful ideas of student-centric approach of teaching and learning. This gives some key consideration that must be incorporated in the student learning process like: students must have the ability to handle different issues appropriately; they should have the skills to apply the designing standards legitimately to productively track successive considerations. Every organization is incorporating these strategies to guarantee that their training must meet them and will delineate outcomes of the learning.

B. Course Outcomes

Course outcomes depict the aptitudes, learning, ability, knowledge and skills which a learner ought to have after the completion of the courses opted by him. The Accreditation Board for Engineering and Technology (ABET) is worried about the quality teaching in the different fields. Outlining of the course instills different angles which are essential to accomplish Outcome Based Education. Outlining of the course comprises of different basic components like goals and objectives (Outcomes, Bloom's Taxonomy, course specific goals and objectives), assessment (classroom assessment techniques, tests, surveys and other measures) and instructions (active and cooperative learning, problem based learning, instructional technology, lectures and labs).

Objectives of the course ought to be clearly defined by keeping into account the fundamental contemplations of Bloom's Taxonomy. Instructions to the students to be given in the form of labs or instructional content ought to be given to such an extent that it turns out to be an issue based, dynamic and helpful learning approach [5]. A portion of the keywords that are utilized to ensure the course outcomes are ability, characterize, outline, recall, think, apply, resolve, rehash, depict, clarify, examine, analyze, investigation, infer, perform, figure and so forth. Nearness of these keywords towards the positive side guarantees the satisfaction of the related course outcome attainment. Subsequently these keywords are utilized as the measuring instrument to delineate the measurement estimation of the course outcome attained.

C. Outcome Based Education (OBE)

OBE assists specialist to investigate the diverse ways that are required for solving the problem under examination more proficiently. Tshai et al [6] states that OBE put concentration on the two fundamental parts in a scholarly program which are valuable for the assessment of the students' performance and accomplishment i.e. POs and PEOs and performed the indirect assessment of Programme Educational Objectives (PEOs).

Final-design down principle helps to elaborate the concept of OBE as described in figure 1.2.

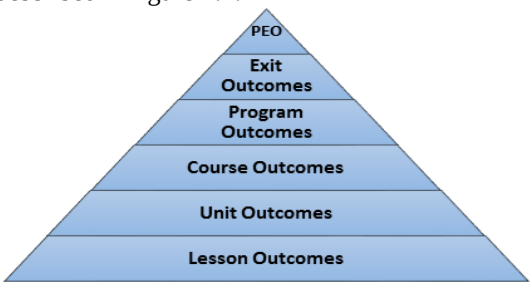

Figure 1.2: Top-Down Hierarchy of outcomes

It depicts OBE is comprising of six levels. In this chain of command, each level beneath the progressive system is gotten from the level present higher in the order. In this

indirect assessment tool, the initial step is to recognize and characterize the stakeholders, plot as: the individuals from college, staff individuals, proficient social and administrative bodies, current understudy, outside officials, graduated class (use for approval), industry etc. The principle evaluation technique utilized as a part of calculating the level of PEOs attainment through an online survey. In addition, the arrangement of questions must be modified for different courses. However, in this reviews from outside stakeholders like employers were not considered. Mapping is likewise constrained to PEOs, which can be stretched out to CO-PO mapping to accomplish more approved outcomes.

OBE accomplishment assumes the pivotal part and has many preferences in the field of instruction as:

- Helps to comprehend instructors about learners' desires from them.
- Helps to expand learners' fulfillment level, as learners are now more open with the instruction framework.
- Helps instructor to look over the level of comprehension and the kind of learning result.
- Helps in incrementing the desire rate. As more are the desires of the understudy, more is his/her enthusiasm for the particular course. The resultant gives us great outcomes.
- Helps the understudies to comprehend the significance of the course which he/she needs to learn.

These focal points put light on the significance of OBE in instructive settings.

D. Survey Essentials

Burkey and Kuechler [7] states that Surveys help to enhance the working of any organization by giving the learning, defects and loopholes present in any system. Appropriate well-ordered strategy is required for the creation and conduction of viable surveys. The six levels are depicted to be specific: rundown of inquiries, organize, estimation, organization, pilot variant, test for optimal survey creation, conduction and its automatic evaluation. Yield of each level in the structure is the contribution to the following stage. Following these levels directs the dependable reviews and give ideal outcomes.

In the level 1 of the structure, rundown of questions is prepared utilizing the imperative keywords related with the examination. At that point in the following level these questions are organized to refine the recorded inquiries to convey it nearer to the form on which information gain could be accomplished. In level 3 ways are accomplished to do the factual examination and legitimate measuring of the responses. In level 4 yield of past stages are fused to send the composed review for pilot test stage. In initial four stages bias reduction issues are settled. In the last two levels pilot test utilizing the sample population is directed to discover the loopholes. At that point the genuine testing is performed. After the fulfillment of these six levels, the survey so composed is sent for development. A web survey gives more prominent availability, productivity and consistency.

Burkey and Kuechler [7] portrays the Morrel-Samuels system comprising of the principles and rules depicting the review conduction process. In this different viewpoints that emerge while the advancement of studies is considered like cost, effectiveness, throughput and execution and so on. It turns out to be a decent guide in the corporate data gathering. This system portrays the means utilized as a part of the conduction of powerful review. All the six stages beginning from the List of Questions to the Deployment stage are essential for the successful review.

III. RECENT TRENDS IN EDUCATIONAL ACTIVITIES

Outcome Based Education (OBE) is the emerging and most critical idea in the field of instructive data mining. Much research has been done in this key region. As a result of its significance, the interest for new research is consistently expanding. This prompts the advancement of new methodologies, strategies, tools, systems and advances for the refinement of already established concepts.

A. Outcome Based Education

Sindhuja and Geetha [8] portrays the definition of learning outcomes and evaluation techniques for learning. It mirrors the significance of center courses for which the course outcomes should be characterized. Hence the course is outlined to such an extent that the probability to achieve the results is likewise expanded.

Mead and Bannett [9] delineates the assessment criteria of the learning outcomes in view of the Bloom's scientific classification. This model portrays the structure in which with each ABET criteria the performance measures are related. In the 1950s, Bloom's work (1956) in creating scientific categorizations for educational objectives were turned out to be imperative and these scientific categorizations in the long run turned into the benchmarks which were utilized as a part of the assessment targets.

Crespo et al [10] proposed the model for the outcome based evaluation and contrasted it with the present condition of learning outcomes in Europe. Their exploration expressed the significance of learning outcomes (aptitudes, information, knowledge and ability) to accomplish OBE. In this approach the performance was evaluated with the assistance of formative assessment and the final result i.e. learning outcome was represented with the assistance of summative assessment. It played out the mix of the distinctive key ideas of OBE like learning outcomes, unit outcomes and the key assessment ideas. In [2] accomplishment of outcomes was simply in view of developmental assessments and summative evaluation. In this assessment construct depends absolutely upon marks. No indirect method for evaluation like survey was considered.

Deng et al [11] executed the structure realated to the different ideas of Engineering Accreditation Criteria (EAC 2000) and Accreditation Board for Engineering and Technology (ABET 2000) in mechanical for under-graduate learners. SEAARK approach of instructing is embraced for checking the achievement of these outcomes, where SEAARK stands for Synthesis, Evaluation, Analysis, Application, Repetition and Knowledge. This entire approach was based around the working criteria of Bloom's taxanomy [9], [11]. Through this model the mapping of the course outcomes is done with the characterized program outcomes. After that the final products are mapped with the ABET evaluation criteria. The understudies' learning outcomes' attainment assessment and evaluation are the general criteria detailed by (ABET 2012) in the United States and the Australian Graduate Attributes defined by the Engineers Australia (2005).

Shuman et al [12] states that the new Accreditation Board of building and Technology i.e. ABET (EC 2000) characterizes 11 outcomes that must be instilled in the teaching learning process. A system is assembled utilizing the Bloom's scientific classification [9], [12] to fulfill this procedure. Every outcome comprises of the attributes which can be additionally utilized as a part of the adjustment procedure of PO fulfillment under different building courses. These characteristics can be "general properties" for instance applying, understanding, depicting and so forth, and also can likewise be "engaged traits" like combining, centering, explaining and so forth. Every result can translate contrastingly relying on the establishment's vision, mission and program goals.

Khalifa and Lam [13] states the impact of web-based learning approach on the learning outcomes. Online learning has evacuated the impediments of the traditional learning perspectives and improved the learning outcomes by influencing how to make teaching learning process more basic and powerful. It removes the transient and spatial issues of learning. In this exploration following two conditions were thought about to inspect the effect of web-based learning: Distributed Interactive Learning (DIL) and Distributed Passive Learning (DPL). In DIL the learning material gave was in more exploratory frame and was available in the hypertext design. Then again in DPL the web was utilized as the source to convey the learning material to sum things up just through power points, spread sheets, word records and some more. Therefore, it is demonstrated that DIL is more ideal approach of learning than DPL. DIL is known as dynamic/hypertext approach of learning.

Mansor et al [14] proposes the assessment of the outcome based training's targets related with the non-examinable courses like short term courses, minor undertakings and workshops and so on. These courses are not ready to be mapped ideally utilizing the ordinary methods of assessment. So, for the most part these are not subject to the assessment criteria with respect to the rules given with regards to ABET. In this framework, the best possible assessment conspire is presented portraying the understudies' raw marks, at that point utilizing the indicator plots the CO and PO scores are delineated. After the mapping of the course and program outcomes, the aggregate scores of mapped CO and PO are registered to check the fulfillment status. Continuous Quality Improvement Program (CQI) is likewise embraced to do the total assessment.

Turns et al [15] builds up a system that is utilized for the assessment of the engineering students. In this exploration concept maps are utilized to do the assessment. These concept maps comprise of the nodes and (connections) which are utilized to represents the students' learning. The mapping exercise at both course and program level is finished utilizing these concept maps.

Azian et al [16] states the significance to accomplish OBE for course advancement and the planning of the item. (EAC) has made OBE mandatory. Because of this OBE has turned out to be more pervasive in Malaysia and everywhere throughout the world. Every CO can be mapped to more than one PO. They utilizes two ways to do the assessment i.e. the seggregated estimation and the immediate estimation. In the immediate estimation process, one and every CO achievement mirrors the PO fulfillment totally while in seggregated estimation process CO and PO are all things considered as one individual character to check for the accomplishment. If CO and PO not met with the achieved levels at that point backtracking procedure is adopted to discover the issues. PO and CO mapping is performed on the premise of different markers like test, task, activities and considerably more.

B. Survey Designing Tool

Mackerron [17] presents a seven phase procedure of directing a successful study which is performed end-to-end as: distinguishing the goals of the examination, recognizing the intended interest group appropriate for the exploration, planning of the inspecting method to be joined, outlining of the surveys, applying the pilot test approach, circulating the confined polls, measurable investigating of the outcomes and composing a report. The end-to-end process leads each progression of seven phase process. It arranges the target group for viable review planning into two general classifications. The essential gathering of people is basically depicted as the gathering of individuals who are engaged with the outlining of the review polls specifically and the auxiliary group of onlookers is portrayed as the client of these overview frames, who utilizes the aftereffects of investigation.

Mackerron [17] in his examination recorded different survey tools (Limesurvey, SurveyMonkey, QuestionPro, Zoomerang, Wufoo and so forth) and furthermore does the correlation of these to investigate which device is superior to other as far as execution, convenience, proficiency, simple to take GUI and cost productivity and so forth. Mackerron in his examination displays a one of a kind model to be specific Websperiment a Domain Specific Language (DSL) show, which is utilized to plan and direct the online surveys all the

more ideally. Then again LimeSurvey is likewise extremely valuable instrument for naturally planning the overview surveys. This tool produces the reports adequately as diagrams, bar graphs, pie outlines, html reports and pdf reports and some more.

Chung et al [18] finds the effect of simulation based subjects in light of understudies' figuring out how to accomplish outcome based training. The course related concepts were inculcated and the assessment is done in view of the learning targets characterized by the specific course. The evaluation status depends on the distinctive methods for managing the complex issues, noting open-ended inquiries and capacity to perform in the troublesome circumstances. Studies are utilized to outline psychological thinking about the understudies lined up with the outcomes of the course. The diverse procedures embraced have different objectives like building the approach of critical thinking in designing, idea connecting with this present reality applications and creating skills to take care of the complex issues. Utilizing this approach of complex learning, psychological advancement can't be evaluated. Additionally this approach is less institutionalized and approved one.

IV. CONCLUSION

Outcome based assessment is the key essential aspect of any educational activity. Not much work has been done in attainment of outcomes using automatic indirect assessment tools effectively.

This review proposes a unified model for indirect assessment of outcomes. This model brings two major tools collaboratively on a single platform. With this model the need to maintain two separate tools one for survey handling and analysis and other for OBE assessment is not a need now. Online questionnaire survey which is one of the optimal indirect assessment tools serves as the source of potential information. As necessity is the mother of invention. So, due to generation of large quantities of data we need to mine it to extract useful information. An automated survey designing tool can integrate the features required for PO CO mapping. One can use the survey designing tool to design and conduct various surveys automatically and do detailed analysis. Later using their responses, the procedure can be adopted to check whether the PO and CO is met or not and hence the achievement of OBE. In the mapping process each question and its respective attained levels of the survey can be mapped with the individual course outcome and its associated programme outcomes. Later teacher success report can also be generated using this technique. Comparatively in this proposed model the PO CO mapping can be done with the help of feedback from the different surveys (alumni survey, course embedded survey, teacher survey and industrial survey). This improves the result as feedback data always help to refine the process by showing the shortcomings. Classification techniques can be applied to predict the attainment status of COs and POs.

It inputs raw data and does the analysis to discover the knowledge from educational data. It makes good use of raw data collected by e-Learning and educational technology systems. The main advantage of this research is achievement of OBE by introducing learning education, filling gaps in the education and finding the key areas for improvement. It is accomplished by analysis and exploration, by semi-automatic and automatic means, of large quantities of data in order to discover some knowledge. Automation of the outcome attainment process helps the faculty to focus on the scholarly activities rather than manual calculation of all the processes.

V. FUTURE WORK TOWARDS A UNIFIED MODEL FOR OUTCOME BASED ASSESSMENT

Future work that can be done in various directions:

1. Direct assessment tool can be integrated with the automated indirect assessment tool.
2. Weighted assessment can be computed.
3. Course outcomes can be mapped automatically by identifying the keywords of the questions.
4. Recommendation system can be incorporated.

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