



Comprehensive Course-Embedded Assessment System (CCEAS) to Measure Program Learning Outcomes (PLO): Measures that Matters

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ABSTRACT

Continuous efforts are made by many educational researchers and quality experts to measure Program learning outcomes (PLO) by using direct and indirect methods in medical education. To overcome the challenges and limitations in the measurement of PLO, educational researchers use different sources of data to increase the probability that the measured value represents the accurate scenario. In the recent past, education researchers showed more interest in CCEAS. It emerged from the fact that student learning is assessed all the time in the courses to move ahead in the program. Many higher education institutions (HEI) and accreditation bodies recommend the course-embedded assessment method to measure PLO. However, the HEI uses randomization method to embed the course assessments on the PLO. In all these methods, the measurement of PLO is analyzed to improve the quality of the program than focusing on improving the learners in the program. In the perspective of internal quality assurance, the measurement of PLO is not only the retrospective analysis of the learner's exit the program; rather it should identify the "outcome gap" in the learners of all the phases in the program. Finally, the improvisation must benefit the learners entering the phase as well as the learner's progress to the next phase. The best fitting answer will be "implementation of CCEAS to measure the PLO, and it acts as a magnifying lens to visualize the microenvironment (courses and learners) in the program and analyze the standard of learning and teaching to improve the overall performance of all the learners and program (Assurance of learning (AOL))". However, the importance of macro-level measurement of PLO cannot be negated because it acts as a validation of what is measured and implemented at the micro-level (courses level).

Keywords: Measurement of learning outcomes, Program learning outcomes, Course learning outcomes, Assurance of learning

INTRODUCTION

In recent decades, the measurement of Student learning outcomes (SLO) has become the major concern among quality assurance experts due to its principle position in reflecting the higher education effectiveness and performance [1]. The parents and students are considered as consumers of higher education and their apprehension on the factors such as student learning, performance, and employability pressurized the accreditation and regulatory bodies to enforce the measurement of the higher education outcomes and overall performance [2-4].

Multilevel discussions are trending in and around the SLO's emphasizing the higher education institutions (HEI) to better organize and provide the stimulating learning environment and opportunity for students to achieve the target benchmark of PLO [5]. These discussions focus on the program of enrolled students' to achieve the expected knowledge, skills and competencies (controlled settings such as examination) as well as able to perform and fulfill the demands of the employer (uncontrolled setting such as job requirements). Thus, it becomes vital for an institution to assess the student's achievement of PLO as parts of the annual and periodical review process.

The external assurance agency (assessment and accreditation) have become an inevitable part of HEI to assure and enhance the quality of the program delivered to the students and to achieve its mission, goals, and outcomes [6]. Accreditation process plays a significant role to measure the learning outcomes especially by providing the criteria related to Learning, teaching, and assessment (LTA) of SLO. It is directly related to the standard of learning and teaching and co-related to other standards such as administration and governance, quality assurance, learning resources and facilities, research and scholarship, and field experience [7].

In other words, all the standards in the quality framework work intensively to achieve the PLO. Thus, the accredited agencies influence the Internal quality assurance (IQA) to place the learning outcomes in the center of all events of academia [8]. Further, the accreditation and regulatory bodies urge the HEI to develop appropriate policies and processes (legislation and methods to fulfill the standards and criteria), procedures and tools (implementation) and review mechanisms to assure that learning outcome is effectively delivered, measured and reviewed as evidence of student learning. It results in examining the student learning and systematic identification of the problems and engaging in the improvement of policies and procedures related to LTA of SLO [9,10].

Principles and Concepts

Methods and its application: Many different types of direct and indirect methods are available to measure the PLO. The direct method means data acquired through quantitative and qualitative measurement directly from the students' performance on the learning outcomes (examples: summative assessments-exam, essays, oral presentation, course examination, assignments, progress tests, capstone projects, thesis, portfolio, standardized tests of general education skills and so on). The indirect method means data acquired through quantitative and qualitative measurement of students completing the program (graduate) or former students (alumni). Example: graduation rate, employability rate, license exam passing rate, number of students progressing to an advanced degree, program evaluation survey, exit interviews, alumni survey, employer survey, internship survey, preceptors' survey, course evaluation survey and so on [11-14].

Many HEIs embrace a combination of direct and indirect methods for the measurement of PLO and fix it as a key performance indicator (KPI) for the standard learning and teaching [15]. The evaluation based on job placement, student satisfaction, self-report on the attainment of knowledge and skills cannot provide direct evidence of implementation of policies, processes and procedures of SLO rather it provides evidence on the impact of the program and institution [1,16].

Application of the principle of systematic evidence-based approach on each component of SLO requires the following:

- Explanation of “outcome” and its difference from the other potential dimensions of performance such as output and impact
- Evidence must distinctively represent the analysis of student, program, and institution
- Evidence must differentiate the measurement of SLO explicitly from learning rather than representing other contributing factors in higher education
- Evidence must explain the mechanisms of measurement involved in the assessment of SLO and causes contributing to the result [1]

Input-Process-Output-Outcome-Impact Model

The basic systems model framework presented below has 3 ways of defining the institution or program effectiveness (Figure 1).

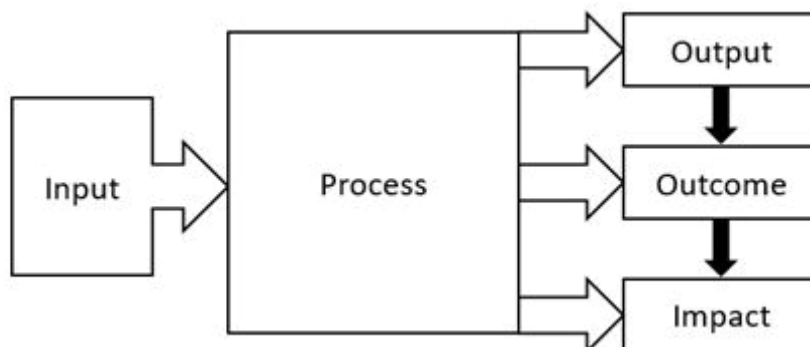


Figure 1 Basic system model in the perspective of an institution or program effectiveness

Input indicates the human, financial and physical resources involved in the institution and programs activities and

services. The process indicates the means to deliver the program, activities, and services in a stimulating learning environment. It includes policies and processes, procedures and tools and its implementation to produce the targeted outputs effectively and achieve the expected outcomes to have its positive impact on the demand of the nation. The output is a result of the institution (includes programs, faculty and student activities) and its investments and is related to quantitative measurements. Outcome focuses on the quality of educational activities and services benefiting the students learning. So it is an aggregate of events that happen to a student in a particular course in a program of HEI. The impact is a holistic view of institutional performance creating a positive and beneficial effect on the fulfillment of need and demand of the nation. It is largely a social factor justifying the institutional purpose and directly related to the achievement of goals and mission [15].

The output and impact are institutional terms and depends upon various interconnecting factors. Thus the measurement does not truly indicate the attainment of students learning measures. The outcome is the term which indicates the student learning and achievement of PLO directly proportional to the institution's performance and effectiveness [1].

The events of the program must be analyzed by the integration of program evaluation, system thinking and Deming's cycle [17-23]. Stages of program execution are program planning (plan/input), implementation of program policies, processes, procedures and tools (do/process), program monitoring and evaluation (check/output, outcome, and impact) and program review and revision (act and continuous quality improvement-PDCA Cycle).

Program planning (plan/input): Preparation of the program is based on the previous evaluation and review process. Example of documents-program specifications, course specifications, policies, rules, and regulations related to all the standards, peer-review report of program and courses specifications, faculties expertise, experience and skills, campus resources, facilities, financial management and planning, risk management and so on. Examples indicators are resource students' ratio, infrastructure students' ratio, faculty students' ratio and so on. The limitations of input indicators are unable to determine the quality of learning and teaching, and only it provides details of requirements for quality of learning and teaching.

Program policies, processes, procedures, and tools implementation (do/process): Execution of the LTA activities of the courses in the program includes hospital and community-oriented services and research and scholarly activities. The implementation stage is very critical to the execution of policies, processes, and procedures which happen at the ground level. Example documents are LTA plan and schedule, course guide, assessment manual, portfolios, workbooks, hospital services, procedures, processes and tools related to validation, moderation, marking, and calibration of assessments, students support and academic counseling, and so on. Example of indicators is faculty workload, students learning experience and assessment fairness (surveys), statistics on faculty development programs, students support, learning assistance, library, learning resources and facilities utilization, and so on. Majority of the indicators are a mere indicator of requirements or represents the subjective experiences of LTA, measured through surveys (indirect measurements).

Program monitoring and evaluation (check/output, outcome, and impact): In this phase, the results are collected and measured and compared to the expected results. Example of documents are students' assignment works, course reports, program reports, action plan progress and follow up reports and so on. Examples of indicators are grade distribution, graduation rate, employment rate, credit hours generated, publication numbers, and the participation rate of faculty development programs. Others are graduate enrollment in residency programs, license examination passing rate, statistics based on the surveys (satisfaction and experience rate) involving intern, alumni, preceptor's, employer, faculty, and patients, etc. Majority of the indicators are representative of indirect measurements or not representing the process. These indicators are the measurement of output, and the impact of the program rather informing the courses level implementation of policies, process, and procedures related to students learning outcomes.

Program review and improvement (act and continuous quality improvement-PDCA cycle): Review of the program involves external and internal review mechanisms on an annual and periodical basis; followed by improvement of the program. Example documents are self-study report based on self-evaluation scale; internal and external review report, and so on (Figure 2).

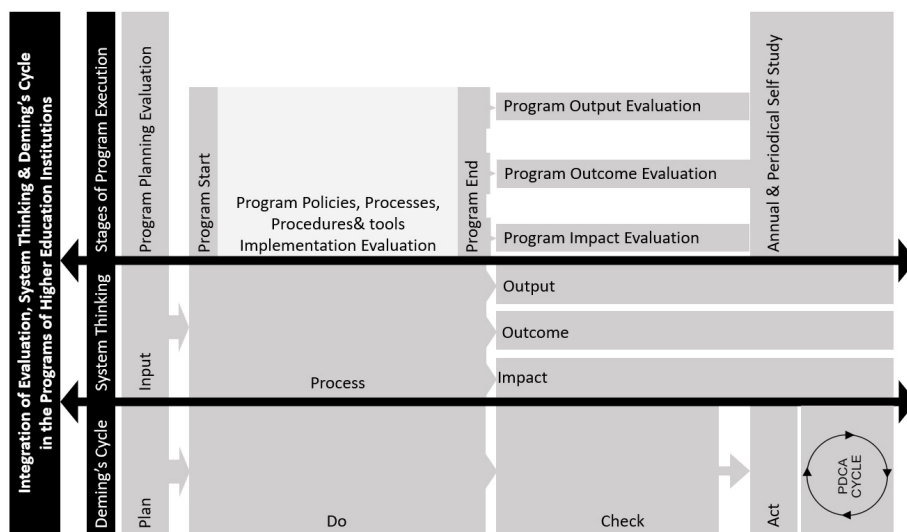


Figure 2 Integration of program evaluation, system thinking and Deming's cycle

The PLO measurement must indicate the status-quo on the implementation of LTA policy, processes, procedures, tools, strategies and methods and also provide information about individual student learning and courses performance in the program. It gathers evidence of students learning through collection and analysis of aggregated data of students' assessments to examine the achievement of PLO. It also includes the evaluation of evidence and its gathering process [24].

The evidence is gathered from the quantitative and qualitative process and also using direct and indirect methods to judge the learning. The data gathered must surpass the survey and employability status; it must include actual examinations of students' performance from all the courses [25,16]. The inputs from all the courses are highly relevant, especially in medical education programs because each course plays a pre-requisite for later phase courses. The design of the program echoes on the attainment knowledge, skills and competencies progressive manner (early phase of the program focuses on more knowledge than the skills and competencies whereas vice-versa in the late phase of the program) (Figure 3) [26-28].

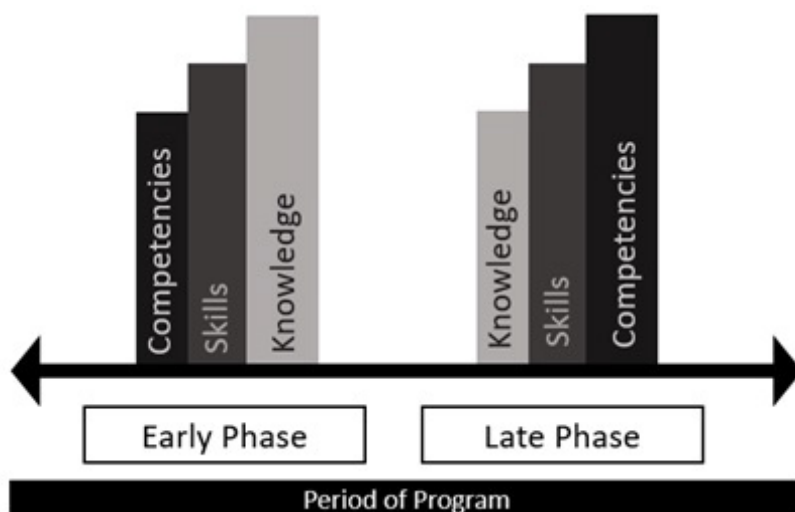


Figure 3 Progressive attainments of knowledge, skills, and competencies. Early phase courses and its learning outcomes target on the integration of basic, clinical, behavioral, and social sciences in medical practice

Late phase courses and its learning outcomes target on the application of scientific cognitive knowledge along with communication, collaboration, professionalism, ethics, research and scholarly skills in patient care and community-oriented practice [29,30].

The step-wise processes involved in LTA of learning outcomes are [31-33]:

- Step 1: Constructive alignment [alignment of sessions learning outcomes (SLO) with course learning outcomes (CLO) then CLO with PLO]
- Step 2: Mapping of CLO by impact level (such as introductory, proficiency, and advanced)
- Step 3: Standardization of learning resources to the mapped level
- Step 4: Corresponding learning and teaching strategies along with its alignment of assessment strategies
- Step 5: Assessment plan (test blueprint and test specifications)
- Step 6: Mapping of all the course assessment on the PLO
- Step 7: Validation and calibration of assessment
- Step 8: Moderation and marking of assessments
- Step 9: Item, psychometric and benchmark analysis on the achievement of CLO and PLO
- Step 10: Verification of students achievements

The above mentioned 10 steps are very crucial in determining the attainment of expected students' outcomes in knowledge, skills, and competencies.

The system involved in PLO measurement should gather direct (from examinations-reflects student attainment of learning outcomes) and indirect (from outcome-based course evaluation survey-reflects students' perception of learning outcomes) evidence about the SLO from the course to engage in psychometric analysis. The analysis acts as a lens to re-examine and review the implementation of process and procedures at the base (sessions) level and ultimately, improve the overall LTA process (and also may lead to policy change) to enhance the achievement of PLO [1,34]. This system of measurement of PLO is called "Comprehensive course-embedded assessment system (CCEAS)." The other methods in the measurement of PLO indicate the impact of the program which depends on the students' achievement of outcomes. Thus, the CCEAS in the measurement of PLO benefits the program administrator to make strategic decisions and results in measurable improvement in the process involved in the learning outcomes.

Comprehensive Course-Embedded Assessment System

Courses are designed and developed for completing a coherent program and therefore it is important for the entire course assessments placement in the context of the program [35]. Consequently, all the assessment of courses can be embedded to demonstrate the achievement of the PLO in addition to the CLO [36,37]. The success of measuring the PLO through the courses depends on the "constructive alignment." In the constructive alignment; learning outcomes, learning experiences, and assessment tasks work together to reinforce mutually, assure and verify the achievement of the CLO. Thus the constructive alignment serves as the foundation for the course-embedded assessment system to measure the PLO [31].

CCEAS analyzes and reviews the implementation of policies, processes, procedures, and tools related to the learning and teaching standards and its effect on the achievement of PLO, the loop ends by the evidence-based improvement in the LTA activities of the program. However, most of the HEI uses random mapping of assessment tasks throughout the program to embed the course assessments on the PLO. After mapping the assessment tasks into the PLO, gaps in the assessment of certain learning outcomes are apparent as well as some learning outcomes over assessed and it is evident in the Australian studies [38-40]. It is happening due to the inherited weakness, i.e., a retrospective organization in the planning of course-embedded assessment. Thus, the random mapping of assessment of courses on the PLO hazy the purpose of measurement of PLO and fail to provide course level inputs which are involved in the progressive development of students' learning. And it is an essential element in medical education because of the phase-wise development of knowledge, skills, and competencies by the students' [29,41].

To overcome these issues CCEAS is deployed and all the course assessment tasks are mapped in a prospective method [42,43]. The assessment tasks must be appropriate to the level of proficiency (according to the mapping matrix), match the assessment strategies, and should be in alignment with the SLO. Biggs's principle of constructive alignment states, SLO aligned with CLO and CLO aligned with PLO. At the higher level, the PLO was aligned with the program goal and mission; then strong alignment was made with the institutional outcome and national qualification framework [31].

As a principle, minimum 2 assessment methods must be employed to assess each of the course learning outcomes (for example; Multiple choice question (MCQ) and short essay questions; clinical portfolio and objective structured clinical examination), following a process (validation of assessment) to ensure that these methods are appropriate for the CLO [44,45]. Multi-stage assessment method (for example mid-course examination and end-course examination) is a requirement for effective implementation of this system. Thus the multiple assessment tasks on the CLO and multi-stage assessment methods enable the course coordinators to do psychometric analysis on validity and reliability on the direct measurement of CLO. Further, the indirect measurement of CLO (outcome based course evaluation survey by students) adds value to the psychometric analysis and it covers the 2 critical perspectives i.e., students' achievement of learning and students' learning experience [46,47].

All the direct and indirect measurement of CLO are transferred into the electronic calculation sheets, which measures the PLO. Each course in any phase of the program can be re-examined based on their achievement of learning outcomes and all the process, procedures and tools involved in learning and teaching can be reviewed. The strategic decision and improvement plans are based on the evidence representing the base (sessions and courses) level.

The comprehensive course-embedded assessment system also identifies the learning gaps among the learners and provides an opportunity to address the identified gaps (for example: identified outcome gap of final year students are addressed by providing an opportunity to get training in Saudi Medical Licencing Exam (SMLE) during their internship year; this results in high performance of that particular cohort in the SMLE). And this system also provides space and opportunity to triangulate all the other data echoing the program output, outcomes and impact and helps to identify the implementation gaps in other policies, process, and procedures related to learning and teaching especially, in the area of student's support, learning resources and facilities availability, governance and administration, and quality assurance. Hence ensures the systematic generation of evidence from the base (sessions) level to the program level [48].

Institutional Intelligence and its Relationship with Measurement of PLO

Institutional intelligence is the ability of the institutional culture to manage and unify the stakeholders and their activities to achieve the institution mission without compromising the values. It depends on the 4 factors like stakeholder's guidance, stakeholders support, stakeholder's development and stakeholders reward [49]. Institutional intelligence is directly proportional to the emotional intelligence (ability to manage ourselves and our relationships effectively-consists of 4 fundamental capabilities: self-awareness, self-management, social awareness, and social skill); ultimately it depends upon the leadership and his styles in managing the factors related to institutional and emotional intelligence [50].

CCEAS based PLO measurement has advantages over the other methods as it gives complete details on the implementation of process happening at base (sessions) level. It demonstrates that the system and process determine the quality of learning and teaching. It recapitulates Deming's red bead experiment that demonstrates the 14 points of quality management [51,52]. The experiment emphasizes that quality depends on the effective process in the system. It is vital for the institutional leadership and top management to recognize and innovate systems that review and improve the process of learning and teaching, ultimately decides the students' achievement of PLO [53,54].

The above-described system may give a perception of an extra burden, inconvenience, and resistance among the faculty members. It can be overcome by following institutional activities practice that adapts to the culture of quality learning and teaching:

- Establishment of a center for LTA [55]
- Resource allocation for measurement of PLO [56]
- Faculty development program: special training and workshops [57]
- Including the measurement of PLO in the scholarly activity [58]
- Collaboration and cross-institutional benchmarking related to the measurement of PLO [59,60]
- Engaging students in the assessment feedback and reflective practices (formative use of summative assessment, bridging the formative and summative assessments in the analysis-a concept of assurance of learning) [61]
- Software development for mapping the assessments [62]

- Psychometric analysis support and training. Enhancing the survey unit-equipped with software, and experts in the field of educational psychology and learning analytics [63,64]
- Continuous improvement in the assessment methods such as rubric scoring for various competencies especially involving the communication and collaboration, professionalism, and research and scholarship [65-68]
- Continuous improvement in the course-embedded assessment system to enhance the analysis through correlation of other input indicators to improve the input factors affecting the process and outcome [69]

Finally, the measurement of PLO improves the quality of the LTA process but hugely depends upon the institution's approach towards quality culture. In the recent past, the accountability, compliance and control mechanisms of regulatory bodies act as a driving force to develop a system to measure PLO in the HEI [6].

In our experience, the coercive implementation of assessment on the accountability and institutional approach "student as a customer" can bring quality culture at the level of documentation but not in reality and it will increase the gap between the managers and academicians [70]. The leadership holds high-value for academicians and student centeredness and exhibit positive behavior (affiliative, democratic, pacesetting and coaching) can bridge the gap between the managers and academicians as well as academicians and students. It is vital because the major stakeholders involved in the quality of learning and teaching are academicians and students [71-73].

CONCLUSION

The development of quality culture and accountability for improvement should start with the top level management, and it will promote faculty and student excellence. The optimistic leadership and LTA center play a vital role in promoting a quality culture that values a comprehensive course-embedded assessment system to measure the PLO and review the process and procedures to improve the quality learning and teaching.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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