Embedded Course Level Assessment for Effective Assessment of Program Learning Outcomes

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Abstract

Learning outcomes assessment is an effective academic quality assurance tool that enables educators to review and enhance the alignment between planned, delivered, and experienced curricula. Accurately assessing what students know and are able to do after completing a learning module is the first step to decide on the strategies to implement and the proper actions to take in order to ensure the continuous improvement of the student learning experience. This paper introduces a simple process for effectively assessing the intended program learning outcomes using assessment data collected at the course level. The process takes advantages of the assessment instruments used regularly by course instructors to assess their students in the classroom. This would help the program collect effective assessment data, while reducing the assessment load and not overwhelming faculty with extra assessment tasks.

Keywords: Assessment, continuous improvement, learning outcomes, curriculum alignment.

1. Introduction

Educating the next generation of students and preparing them for the job market has always been the core business of higher education institutions. With the emergence of the fourth industrial revolution and the ubiquity of internet technologies and applications, higher education institutions are currently facing several novel challenges. Four of these major challenges have been identified recently by the World Economic Forum as the increasing need for life-long learning; the evolving needs and expectations of students; the emerging technologies and business models; and the transition towards a "skills over degrees" model (Østergaard & Nordlund, 2019). Other major challenges include global competition, the increasing social and geographical diversity of the student body, and the reduction in state and federal funding.

While addressing the above challenges, higher education institutions are still required to provide quality education and to prepare students with the required skills and competencies to deal with an extremely dynamic job market. Nevertheless, several shortcomings have been identified by a recent study conducted by IBM's Institute for Business Value. The study surveyed the opinion of industry and academic leaders on the contemporary issues confronting higher education. The results of the study published by Forbes magazine (Morrison, 2015) indicated that only 43% out of the 1,000 industry and academia leaders surveyed felt that higher education gave students the skills they needed to join the job market. Moreover, only 41% believed that higher education met the industry needs.

Therefore, there is currently a considerable pressure from governments and academic accreditation agencies on higher education institutions to improve the effectiveness of their teaching practices to overcome the above challenges and shortcomings. For instance, the Australian Vice Chancellors' Committee stated in its guidelines for effective university teaching that "the promotion of effective teaching should be a matter of highest priority for each university and that each institution needs to develop a coherent set of policies and practices which demonstrate that the institution values above all else the education of its students and the contributions that academic staff make to the enhancement of student learning" (Aylett & Gregory, 1996). Teaching effectiveness, continuous improvement, and the ability of students to achieve their intended learning outcomes are also of utmost importance for several institutional and academic accreditation agencies including WASC, SACS, ABET, and AACSB, among others.

For a higher education institution to successfully promote effective teaching, its policies and procedures should define what effective teaching is, and how it can be measured and improved. Measuring teaching effectiveness in higher education environments, however, is not as easy as measuring research and service effectiveness. Evidence of research and service activities are usually public in nature, which makes them easier to locate and evaluate.

Teaching activities, on the other hand, take place behind closed doors, where only students and their instructors are usually involved. Hence, many universities rely on tools such as students' evaluation of teaching, peer evaluation of teaching, and course portfolios to collect evidence regarding the extent to which teaching and learning has taken place (Aylett & Gregory, 1996; Buckridge, 2008; Cerbin, 1994; De Rijdt et al., 2006; Melland & Volden, 1996; Shao et al., 2007). Other evaluation tools such as achievement of learning outcomes, teaching related publications, and teaching awards are also mentioned in literature (Berk, 2005).

Among the tools mentioned above, Learning Outcomes Assessment (LOA) provide educators with an effective tool to review and enhance the alignment between the planned, delivered and experienced curriculum. LOA processes could be used for obtaining reliable information to answer the following questions:

- Are students achieving the intended outcomes?
- Are they learning the required skills to succeed in this field or profession?
- Is the program continuously improving the students learning experience?
- Should the curriculum or the teaching strategies be modified?
- Are there other techniques or additional resources that would help students learn more effectively?

Answering the above questions would help educators decide on the proper actions to take and the strategies to implement in order to ensure the continuous improvement of the student learning experience, and the achievement of the intended learning outcomes.

This paper introduces a simple process for effectively assessing the intended program learning outcomes using assessment data collected at the course level. The process takes advantages of the assessment instruments used regularly by course instructors to assess their students in the classroom. This would help the program collect effective assessment data, while reducing the assessment load and not overwhelming faculty with extra assessment tasks. The remaining of the paper is organized as follows: Outcome-based teaching mode and its alignment maps are introduced in Section 2. The proposed PLO assessment method using the calculated CLOs assessment results is introduced in Section 3, followed by discussion remarks in Section 4.

2. Alignment Maps in Outcomes-Based Curriculum

Designing a program that addresses the above challenges starts by a careful definition of the intended program learning outcomes (PLOs) that describe the knowledge, skills, and competencies the students should have or be able to demonstrate upon the successful completion of the program requirements. The defined outcomes should provide students with

competencies and skills that are current and relevant to the 21st century competitive job market. They should be also aligned with the program and the college goals/objectives.

Abate et al. (2003) consider the development of PLOs as the foundation of building an outcomes-based curriculum. Once the PLOs are defined and approved, curriculum and learning strategies are developed to support their achievement. As such, the curriculum development is student centric and guided by what the student will be able to do at the end of each module rather than simply using modules content and subject areas as the guidelines (Thomas et al., 2015). Developed curricula should demonstrate through curriculum alignment that offered courses, learning activities, and assessment methods provide students with enough opportunities to achieve the intended PLOs at the introductory, developed, and mastery levels.

Curriculum alignment is an essential element of the curriculum development as it assures that the students have different opportunities to achieve the intended outcomes by graduation. It is also used to identify curriculum gaps and redundancy and to ensure that that appropriate assessment tools are used to assess each outcome. At the top level, a curriculum map is used to show how the offered courses contribute to the achievement of each PLO. This map is important as it clearly identify where PLOs are weakly, appropriately, or excessively covered by the offered curriculum. If a weak coverage is identified for a PLO (i.e., curriculum gap), the offered curriculum must be reconsidered to enhance its coverage.

Since each course could contribute to several PLOs at different levels, a second and more detailed map is needed to show how the alignment between the course learning outcomes (CLOs) and the PLOs. The CLOs must contribute to the achievement of the program PLOs, while each course does that to a different degree and in a different way. Thus, individual courses serve different purposes, and it is the collective learning across all courses that enables the student to achieve the overall PLOs. Extra caution is paid to the alignment of the CLO blooms taxonomy cognitive level with the PLO proficiency level.

In addition to the above two alignment maps, another map is needed to align the course topical outlines (CTOs) with the CLOs. This map is essential to assure that the offered topics are aligned with the blooms taxonomy cognitive level specified by the CLO. It is also important for closing the assessment loop, as it can be used to accurately identify the topics contributing to a specific CLO. Hence, allows course coordinators to design effective remedial actions targeting the areas of weaknesses. Each CLO must be covered by at least one CTO.

3. Assess PLOs Using CLOs Assessment Data

Since quality and excellence in education are important to all aspects of society, focus has been placed upon the assessment strategies to assure that programs are continuously improving and accomplishing their missions. Programs are expected to assess the defined outcomes regularly through a periodic assessment plan (Huba & Freed, 1999; Kuh & Ewell, 2010). The aim of the assessment plan is to provide programs with the required evidence for making informed changes in the curriculum to improve student performance. During each cycle, multiple assessment tools are used to measure the students' attainment of the intended outcomes at the end of the learning module. The collected assessment data are analyzed and compared against predefined targets to determine which outcomes the students have attained and which ones need improvement. Remedial actions are then recommended to address any revealed deficiencies, and the assessment loop is closed after the recommended remedial actions are implemented, and their impact are measured. To ensure the effectiveness of the assessment plan, another map is used to align the assessment instruments selected by the program with the each CLO and PLO

The first step in the assessment plan is to identify the most appropriate assessment methods that will be used to assess each outcome. An appropriate assessment method should be able to measure the competency addressed by the outcome effectively and accurately. It is essential that the selected assessment tool and the outcome belong to the same blooms taxonomy level. For instance, Blooms Taxonomy level one questions such as describe or explain are inappropriate to assess a higher cognitive level such as analysis, or design.

To streamline the assessment process at the course and program level, an online learning outcomes management system has been recently developed and deployed at (*removed for blind review*). The system provides programs with a user-friendly interface to build the different alignment maps mentioned above. Faculty use the system throughout the academic semester to submit the assessment data collected using regular course level assessment tools (e.g., tests, quizzes, projects, etc.). Once the assessment data for of tool t is submitted for CLO 'c', the system calculate the attainment level ($A_{t,c}$) as the percentage of students scored $\geq th_c$, where th_c is the predefined attainment threshold for tool t. If multiple tools are used to assess the same CLO, the system allows the course instructor to assign a weight ($W_{t,c}$) for each 't' when used to assess CLO 'c'. By the end of the semester, the system calculates the attainment result for CLO 'c' as:

$$A_c = \frac{\sum_t A_{t,c} \times w_{t,c}}{\sum_t w_{t,c}} \qquad (1)$$

If multiple sections are offered for a given course, after calculating the achievement score of each section, the system advances the status of the course workflow to "calculate the course assessment score" and calculates the overall attainment score of the CLO as

$$A_c = \frac{\sum_s A_{c,s} \times n_s}{\sum_s n_s} \qquad (2)$$

The system also uses the CLO attainment results regularly calculated at the end of each semester as a direct assessment tool to calculate the PLOs attainment level. Out of the list of courses aligned with a PLO, the system identifies the courses aligned at the mastery level. The CLOs/PLOS alignment map is then used to identify the CLOs of the mastery level courses aligned with the PLO. The attainment results of the identified CLOs are then aggregated using a weighted average formula to calculate the attainment result for the PLO.

$$A_{p,CLO} = \frac{\sum_C A_c \times n_c \times W_c}{\sum_C n_c \times W_c} \qquad (3)$$

Where n_c is the number of students measured for CLO 'c', and W_c is the weight assigned to the CLO. The system allows the program to assign different weights to different CLOs, as some CLOs might contribute by different weights to the attainment of the PLOs. This weight is part of CLOS/PLOS alignment map. The PLO attainment results are analyzed by comparing the calculated attainment results with target attainment threshold, and the attainment results calculated by other tools such as graduation projects, capstone courses.

4. Discussion

The learning outcomes assessment system was deployed starting Fall 2018. It has been used since then to streamline the assessment processes at the course and program level. Table 1 shows the assessment statistics for the 2020-2021 academic year. It shows that 11960 CLOs are defined in the system for 2415 active courses. While 626 PLOs are defined for 90 academic programs. Out of the 11960 CLOs, 4509 are aligned with 546 PLOs. The 148 unaligned With regard to the assessment efforts in AY2021, out of the 1678 courses selected for assessment, 1535 courses were assessed successfully (91.5%). In terms of CLOs, 7428 CLOs where assessed out of the planned 7950 CLOs. Figure 1 shows the CLO assessment statistics for the last five semesters. It shows a steady increase in the number of percentage of assessed CLOs each semester. Out of the 5778 CLOs offered in Fall 2021, 5539 were assessed successfully (96%)

At the program level, 322 PLOs were planned for assessment, out of which 297 were assessed successfully (92%). Out of the 297 assessed PLOs, CLO assessment results were used to

Table 1. Assessment Statistics for 2020-2021 Academic Year

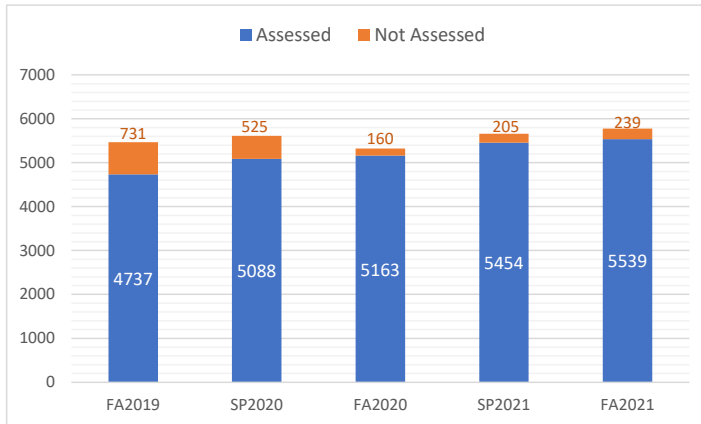|	PLOs	Aligned PLOs	Course	CLOs	Aligned CLOs
Active	626	599	2415	11960	4509
Planned	322	296	1678	7950	2170
Assessed	297	284	1535	7428	2063

Figure 1. CLO Assessment Status

assess 284 PLOs. CLOs assessment results were the only assessment tool used to assess 163 out of the 297 assessed PLOs, while other assessment tools (e.g., capstone, graduation projects, internship experience, and exit exams) were used to assess 134 PLOs.

Although programs are strongly encouraged to utilize multiple tools to assess PLOs, the above statistics show clearly that more than 54% of the programs still rely on the assessment results collected at the course level as the only tool for PLO assessment. This is meanly because some programs are still not clear on how to utilize the extremely useful data collected from capstone courses, graduation projects, and internship experience for PLO assessment. To overcome this issue, starting the 2021-2022 academic year, a new feature was added to the learning outcomes assessment management system that allows programs to define assessment rubrics for individual PLOs and embed them at the course level. At the beginning of each semester, each program decides on the rubrics to be uses, and selects the courses where the data for the rubric will be collected. The course instructor is required to evaluate his/her students based on the provided rubric and submit the data to the system.

References

Abate, M. A., Stamatakis, M. K., & Haggett, R. R. (2003). Excellence in Curriculum Development and Assessment. *American Journal of Pharmaceutical Education*, *67*(1/4), 478–500.

Aylett, R., & Gregory, K. (1996). *Evaluating Teacher Quality in Higher Education*. Psychology Press.

Berk, R. (2005). Survey of 12 Strategies to Measure Teaching Effectiveness. *International Journal of Teaching and Learning in Higher Education*, *17*(1), 48–62.

Buckridge, M. (2008). Teaching portfolios: Their role in teaching and learning policy. *International Journal for Academic Development*, *13*(2), 117–127.

Cerbin, W. (1994). The Course Portfolio as a Tool for Continuous Improvement of Teaching and Learning. *Journal on Excellence in College Teaching*, *5*(1), 95–105.

De Rijdt, C., Tiquet, E., Dochy, F., & Devolder, M. (2006). Teaching portfolios in higher education and their effects: An explorative study. *Teaching and Teacher Education*, *22*(8), 1084–1093.

Edgerton, R., Hutchings, P., & Quinlan, K. (1995). *The Teaching Portfolio: Capturing the Scholarship in Teaching*. American Association for Higher Education.

Fong, R. W., Lee, J. C., Chang, C., Zhang, Z., Ngai, A. C., & Lim, C. P. (2014). Digital teaching portfolio in higher education: Examining colleagues' perceptions to inform implementation strategies. *The Internet and Higher Education*, *20*, 60–68.

Huba, M. E., & Freed, J. E. (1999). *Learner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning* (1st edition). Pearson.

Kuh, G. D., & Ewell, P. T. (2010). The State of Learning Outcomes Assessment in the United States. *Higher Education Management and Policy*, *22*(1), 1–20. https://doi.org/10.1787/hemp-22-5ks5dlhqbfr1

Melland, H. I., & Volden, C. M. (1996). Teaching Portfolios for Faculty Evaluation. *Nurse Educator*, *21*(2), 35–38.

Morrison, N. (2015). *Higher Education "Is Failing Students And Employers."* Forbes. https://www.forbes.com/sites/nickmorrison/2015/07/09/higher-education-is-failing-students-and-employers/

Østergaard, S. F., & Nordlund, A. G. (2019, December 20). *The 4 biggest challenges to our higher education model – and what to do about them*. World Economic Forum. https://www.weforum.org/agenda/2019/12/fourth-industrial-revolution-higher-education-challenges/

Schneckenberg, D. (2009). Understanding the real barriers to technology-enhanced innovation in higher education. *Educational Research*, *51*(4), 411–424. https://doi.org/10.1080/00131880903354741

Shao, L. P., Anderson, L. P., & Newsome, M. (2007). Evaluating teaching effectiveness: Where we are and where we should be. *Assessment & Evaluation in Higher Education*, *32*(3), 355–371.

Tartwijk, J. V., Driessen, E., Vleuten, C. V. D., & Stokking, K. (2007). Factors Influencing the Successful Introduction of Portfolios. *Quality in Higher Education*, *13*(1), 69–79. https://doi.org/10.1080/13538320701272813

Thomas, P. A., Kern, D. E., Hughes, M. T., & Chen, B. Y. (2015). *Curriculum development for medical education: A six-step approach*. Johns Hopkins University Press. https://jhu.pure.elsevier.com/en/publications/curriculum-development-for-medical-education-a-six-step-approach