*Journal of Engineering Education Transformations ,*
*Volume 36 , No. 4 , April 2023 , ISSN 2349-2473, eISSN 2394-1707*

*10.16920/jeet/2023/v36i4/23115*

# Assessment of Program Outcomes in Outcome Based Education through Students' Co-Curricular Activities

**Suji Prasad S J[1], Thangatamilan M, Sureshkumar R, Revathi P**
Kongu Engineering College, Erode,TamilNadu India.
sjsujiprasad@gmail.com

**Abstract:** In recent years Outcome Based Education (OBE) has become the focal point in the Indian Higher education system. The National accrediting agency, such as NBA and NAAC expresses the significance of assessing the program outcomes. This paper discusses assessing program outcomes through students' co-curricular activities such as paper and project presentations and internships/industrial projects. The proposed method gives an in-view of the rubrics-based measurement of program outcomes PO1-PO12, PSO1&2 mapped with students' co-curricular activities. The outcome-based assessment of program outcomes will be beneficial in advancing higher education in India.

Keywords: co-curricular activities; internship; outcome based education; paper and project presentation; program outcomes; rubrics

**Suji Prasad S J**
Kongu Engineering College, Erode,TamilNadu India.
sjsujiprasad@gmail.com

## 1. Introduction

In India, engineering educational institutions are accredited by the National Board of Accreditation (NBA). The NBA is a signatory member of the Washington Accord (WA), which focuses on quality in engineering education. The student-centric approach in outcome-based education demands the assessment of POs and these POs measures the student's achievements in knowledge, psychomotor and affective domains NBA (2019).Engineering institutions' autonomous status, placements and quality of education barely demand accreditation.

The implantation of outcome-based education has become the primary requirement of ABET accreditation. Direct and indirect methods must be practiced to achieve the objectives and goals of the program. The formalized assessment plan defines a structured process and the knowledge, skills and attitudes are measured through the information from students and faculty. Strong educational effectiveness and program development can be achieved by employing continuous assessment of knowledge, skill and competency Liew et al (2020).

The US engineering programs are accredited with seven student learning outcomes by ABET. The rubrics-based assessment approach is developed to fit most of the course contents and it can be altered to fit the course contents. The descriptors contain the

competency, performance criteria and performance indicators specified by the student outcomes. The above-said approach discussed by Pejcinovic (2020) allows the teachers to identify students' problems in defining a problem and following ethical guidelines in the capstone project.

Tshai et al. (2014) discusses that the POs and program educational outcomes are the significant components of student achievement in outcome-based education. The author focused on systematically developing program educational outcomes through stakeholders' input. With continuous quality improvement and a well-defined strategy, the attainment of POs shows the students are satisfied with their achievements. Jadhav et al. (2020) studied the requirement of outcome-based education in Indian engineering education. The three components of OBE outcome-based curriculum design, outcome-based teaching learning and outcome-based assessment are to be followed with a structured process to get promising results

Mohanta and Mandal (2019) developed a methodology in outcome-based education framework for measuring the usefulness of student feedback in curriculum design. The criteria used for the measurement are learner engagement, satisfaction, active learning, self-learning and higher-order thinking. The study revealed that student engagement, self-learning and higher-order thinking are promoted with outcome-based education.

A competent and skilled engineer can be produced with industrial involvement in students learning. Lifelong learning, ethics current trends can be imparted with industry participation. The industry interaction can be achieved through industry talks, visits and internships. The soft skills required for the students can also be imparted through the industrial talks. The feedback from students shows that industrial involvement positively impacts the students and meets the expected POs from the students Nordin et al. (2012)

While practicing outcome-based education, the final year of project identification and assessment becomes significant for achieving the regular POs in higher education institutions. The various dimensions of project work such as literature work, objective, model development, reporting and presentation are measured through assessment rubrics. The quality of projects, proper gap identification, better evaluation and performance of students are obtained as a result of pre-defined rubrics Sasipraba et al. (2020).

Often the course delivery and evaluation is focused on assessing the cognitive domain and the students will prepare well for measuring the knowledge domain. But the learning outcomes include psychomotor and affective domains also to be measured in addition to cognitive.

An inclusive assessment method is to be put in place to determine the attainment of all POs. The focus of students on their learning activities will be motivated towards all POs. The data obtained can be used to analyze students, achievements and shortfalls in the three domains. Rahmat (2011).

Student-centric learning and measurement of student performance are the main focus of OBE, which turn out to be the expected practice in engineering education. The direct and indirect tools are used for the analysis and the data obtained from these tools are used to check the required CO attainment level and POs. The proper attainment of course outcomes can only achieve the attainment of POs. The targets can be varied based on the course complexity and competency expected from each PO Jayarekha and Dakshayini(2014).

Wahab et al. (2011) described the knowledge and skill assessment with the PO direct assessment. The evaluation of PO is done with the inclusion of performance indexes since the PO statements provide only the general outcome expected from the students. Since the direct assessment method did not provide CO attainment for every student, the performance indexes-based approach can be used. The annual review and changes in the program level will ensure the progress of students' performance.

The student learning outcomes can also be mapped to skill development opportunities like co-curricular activities. The students' skills in the involvement of extracurricular and co-curricular activities are measured using surveys and these surveys replicate the skills developed by the students in the student organization, programs and events. Soft skills like communication, professionalism, ethical behavior, teamwork, etc. are measured through the co-curricular mapping with POs that comply with accreditation requirements Zeeman et al.(2019).

Higher Education institutions frequently

experience challenges in implementing a model that can reflect students' real performances in the programme outcomes. Liew et al (2021) unveiled the advantages and disadvantages of these models and revealed why the comprehensive culminating model is a better approach in the Malaysian experience.

Matthews et al. (2022) describes it as a unique method that takes into consideration the varying weightage of each course component. This method focused on root cause analysis and corrective actions and also allows the calculation of the PO attainment level based on the CO and Course attainment level and the Program Articulation Matrix. Amirtharaj et al. (2022) discusses a systematic approach for assessment of attainment of outcomes by graduates of a programme in an autonomous engineering college following OBE with CBCS. The procedure and rubrics for assessing the attainment of the outcomes are also discussed. Accreditation is an honouring mechanism used to assess the standards and quality of the education offered by a programme to a student at an institution of higher learning.

## 2. Graduate Attributes and its Assessment

### A. Graduate Attributes and its Measurement

There are 12 Graduate Attributes (GAs) specified by NBA for all engineering programs. These GAs are structured as POs and categorized as PO1-PO12 NBA (2019). The Graduate attributes are as follows;

PO1: Engineering knowledge

PO2: Problem Analysis

PO3: Design/development of solutions

PO4: Conduct investigations of complex problems

PO5: Modern tool usage

PO6: The engineer and society

PO7: Environment and sustainability

PO8: Ethics

PO9: Individual and team work

PO10: Communication

PO11: Project management and finance

PO12: Life-long learning and the Programme Specific Outcomes (PSOs) of Electronics and Instrumentation Engineering Programme are PSO1: Industrial Automation: Develop an industrial instrumentation system and provide automation by using modern automation tools.PSO2: Entrepreneurship: Become an entrepreneur by inculcating the skills of project management and finance with the knowledge of instrumentation technology, Each PO demands competency and these competencies are achieved by performance indices. The theory courses in any engineering discipline contribute to the first five POs. Especially PO6-PO12 along with other POs and PSOs demands attitudes and skills along with knowledge and it cannot be measured by descriptive type examinations AICTE (2018). The rubrics-based assessment approach will be effective in analyzing the affective and skill of a student. The POs 6-12 can be evaluated using student participation in laboratory assignments, project works, internships, industrial visits, in-plant training, paper publications, societal clubs and associations, cultural activities, sports activities, etc.

### B. Formative assessment with Rubrics

The formative assessments encourage the students to identify their strengths and weakness with the specified criteria. The faculty will also be able to assess the students transparently and address their shortfalls. The criteria-specific rubrics-based assessment specifies 'what is expected from students out of the activity. The well-defined rubrics will help in assessing the psychomotor skills and attitudes of the students with grading. The evaluation rubrics consist of criteria, grading and assignment descriptions. The grading scale will be poor to excellent and criteria specify the breakdown of knowledge, skill and attitude expected from the assignment. The grading will be done as 3, 2, 1 and the three criteria used with nine dimensions to assess the knowledge, skill and attitude expected from the assignment.

## 3. Results and Discussion

The mapping of the selected student paper and project presentation and internship/ industrial projects assessment tool with the POs is important in finding out the best attainment. The PO mapping of the student co-curricular activities is shown in Table I.

**Table 1: Mapping Of Pos And Psos With Paper And Project Presentation And Internship/industrial Project**

| Description | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| Paper& Project Presentation | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| Internship/ Industrial project | 3 | 2 | 2 | 2 | 2 | 3 | 3 |
| **Description** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| Paper& Project Presentation | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Internship/ Industrial project | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

From the above table it is observed that based on the knowledge, skill and attitude levels expected for the POs the students' paper and project presentation and internship/ industrial projects are mapped. The mapping is done as '3' for substantial, '2' for moderate and '1' for slight correlation. The PO6, PO7 and PO12 are moderately correlated since the students will be able to get limited experience in lifelong learning, societal issues and sustainability.

The rubrics developed for the assessment of paper and project presentation is shown in Table II.

From the table, II is found that the scaling is done for 1-3 for the criteria such as participation,

**Table 2 : Rubrics For Paper And Project Presentation**

| Scale / Criteria | 3 | 2 | 1 |
|---|---|---|---|
| **Participation** | 90% of students participated in Paper, Project and Idea presentation | 80% of students participated in Paper, Project and Idea presentation | 70% of students participated in Paper, Project and Idea presentation |
| **Achievements** | 25% of students won prize among participants | 20% of students won prize among participants | 10% of students won prize among participants |
| **Innovation** | 5 Conferences /Journals Published | 3Conferences /Journals Published | 2 Conferences /Journals Published |

achievements and innovations as a journal or patent publications to assess the knowledge skill and attitude expected from the assignments. The data collected through google forms for paper and project presentation and shown in Figure 1(a&b).

The data collection is done based on the criteria mentioned in the rubrics and the assignment descriptions. The data required for analysis is collected every year and attainment is calculated at the end of the program. The part of Data collection sheet for paper and project presentation for 2014 batch of 127 students with batch size is shown in Figure 2.

The rubrics developed for the assessment of internship/ industrial project is shown in Table 3.

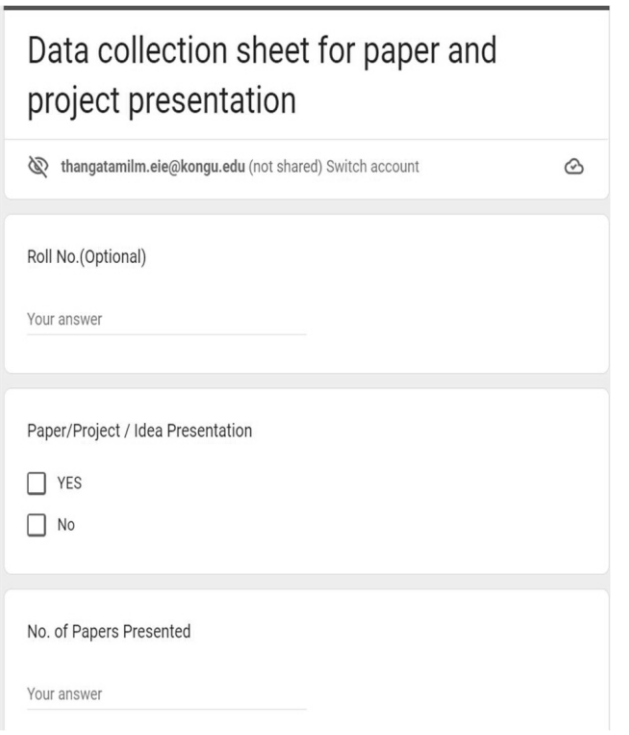


**Fig. 1a. Google form for Internship/Industrial Project**

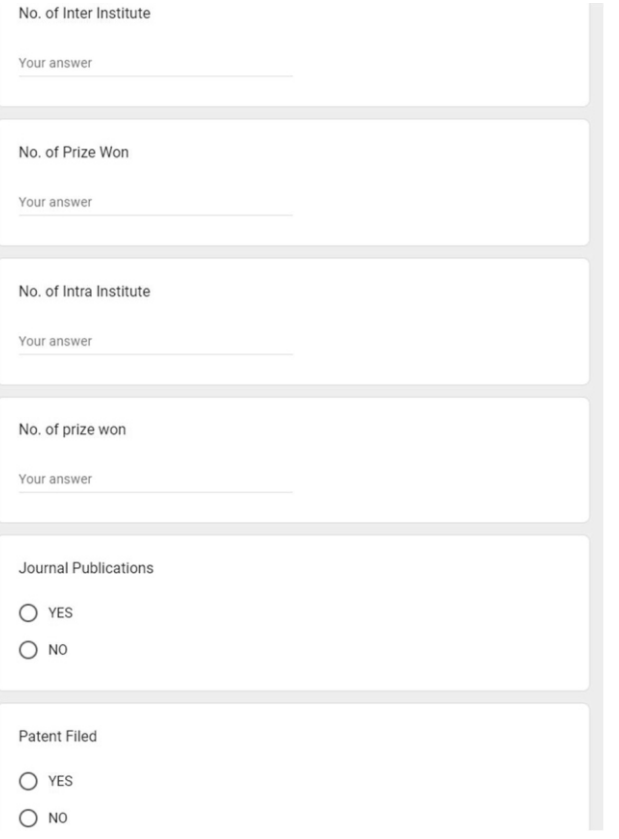


**Fig.1b: Google form for paper and project presentation**

Batch: 2014-2018

| S.No | RollNo | Paper/Project / Idea presentation YES/NO | No of Papers Pressented | No of Inter Institute |
|---|---|---|---|---|
| 1 | 14EIR001 | YES | 4 | 3 |
| 2 | 14EIR002 | YES | 4 | 2 |
| 3 | 14EIR003 | YES | 2 | 1 |
| 4 | 14EIR004 | YES | 3 | 1 |
| 5 | 14EIR005 | YES | 6 | 3 |
| 6 | 14EIR006 | YES | 3 | 2 |
| 7 | 14EIR007 | YES | 3 | 1 |
| 8 | 14EIR009 | YES | 3 | 2 |
| 9 | 14EIR010 | YES | 2 | 2 |
| 10 | 14EIR011 | YES | 3 | |
| . | . | . | . | . |
| . | . | . | . | . |
| 124 | 14EIL128 | NO | 0 | |
| 125 | 14EIL129 | YES | 1 | |
| 126 | 14EIL130 | YES | 1 | |
| 127 | 14EIL131 | YES | 2 | 1 |
| Total Number of Students Participated | | 112 | No of Prizes Won | |
| % of Participation | | 88.19 | % of Prizes Won | |
| Attainment (3/2/1) | | 2 | Attainment (3/2/1) | |

**Fig. 2: Data collection sheet for paper and project presentation**

From the table III, it is found that the scaling is done for 1-3 for the criteria such as participation, identification of internship through self/ placement and internship/ Industrial project reports as well as presentation. The data collection is done based on the criteria mentioned in the rubrics such as percentage of students participated, domain of internship, the offer identified by the students/ placements, detailed reports and well-structured presentation

The data collection for internship is done using google forms. The layout used for data collection is as shown in figure 3 (a&b) and the part of data collected from the students through google forms are shown in figure 4.

**Table 3 : Rubrics For Internship/ Industrial Project**

| Scale / Criteria | 3 | 2 | 1 |
|---|---|---|---|
| **Participation** | 25% and above students participated in internship/ Industrial project | 20% -25% of students participated in internship/ Industrial project | 10%-20% of students participated in internship/ Industrial project |
| **Identification and Domain** | 20 % and above students self-identified and 20 % and above core industries | 10 % -20% of students self-identified and 10-20% core industries | 5 %-10% of students self- identified and 5 %-10% core industries |
| **Reports and Presentation** | Students reports have detailed explanation and presentation | Students reports have explanation and presentation poorly organized way | Students reports have partial explanation of explanation and presentation |

The target of PO and PSO through indirect

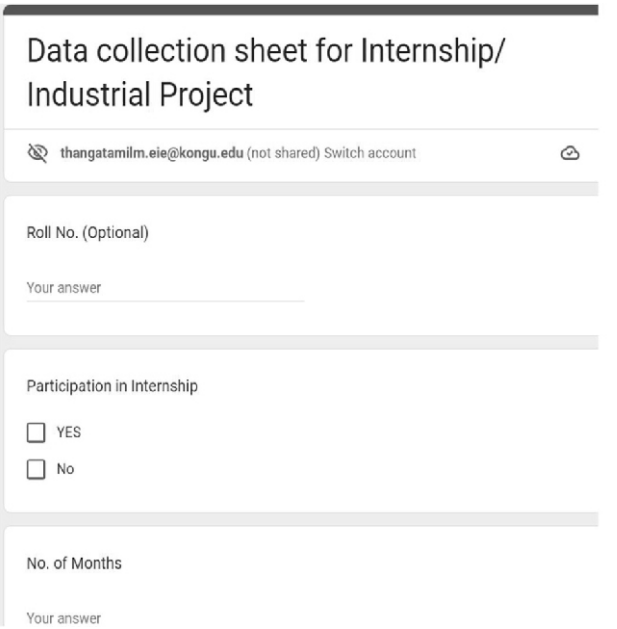


**Fig. 3a: Google form for Internship/Industrial Project**

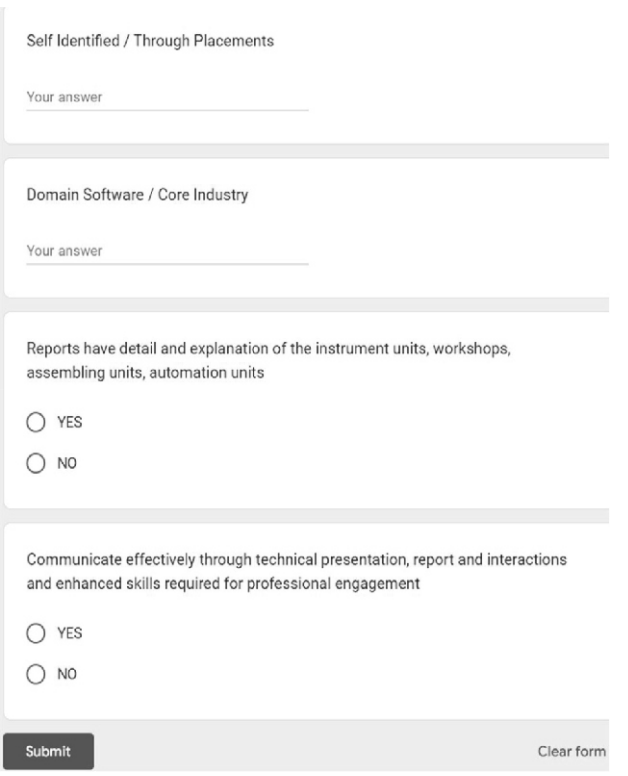


**Fig. 3b: Google form for Internship/Industrial Project**

| Batch : 2014-2018 | | | | | |
|---|---|---|---|---|---|
| S.No | Roll No | Participated in Internship/ Industrial Project YES/NO | No of Months | Self Identified / through Placements | Domain Software / Core Industry |
| 1 | Student-1 | YES | 2 | Through Placement | Software |
| 2 | Student-2 | YES | 2 | Through Placement | Software |
| 3 | Student-3 | NO | | | |
| 4 | Student-4 | NO | | | |
| 5 | Student-5 | YES | 3 | Through Placement | Software |
| 6 | Student-6 | YES | 3 | Through Placement | Core |
| 7 | Student-7 | NO | | | |
| 8 | Student-8 | YES | 2 | Self Identified | Core |
| 9 | Student-9 | NO | | | |
| 10 | Student-10 | NO | | | |
| . | . | . | . | . | . |
| . | . | . | . | . | . |
| 124 | Student-128 | YES | 2 | Self Identified | Core |
| 125 | Student-129 | NO | | | |
| 126 | Student-130 | NO | | | |
| 127 | Student-131 | NO | | | |
| % of Participation | | 41.73 | % in Core industries | | 75.00 |
| Attainment (3/2/1) | | 3 | Attainment (3/2/1) | | 3 |

**Fig 4 : Data collection sheet for Internship/Industrial Project**

assessment tools of student portfolio and its attainment is shown in figure 5.

| Indirect Ass | | | | | | | |
|---|---|---|---|---|---|---|---|
| SI.NO. | Survey | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
| Student Portfolio | Target | 3 | 2.25 | 2.25 | 2.25 | 2.25 | 2.75 |
| | Attainment | 2.83 | 2.08 | 2.08 | 2.08 | 2.08 | 2.64 |
| | Percentage of attainment | 94.33 | 92.44 | 92.44 | 92.44 | 92.44 | 96.00 |

| essment | | | | | | | |
|---|---|---|---|---|---|---|---|
| Program Outcomes | | | | | | | |
| PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| 2.75 | 3 | 3 | 3 | 3 | 2.25 | 3 | 3 |
| 2.64 | 2.83 | 2.83 | 2.83 | 2.83 | 2.08 | 2.83 | 2.83 |
| 96.00 | 94.33 | 94.33 | 94.33 | 94.33 | 92.44 | 94.33 | 94.33 |

**Fig. 5 : Target and attainment of PO and PSOs through student portfolio**

In paper and project presentations the, substantial attainment is achieved by having a batch with 88.19% participation, more than 25% (i.e., 44.88%) won prizes out of participation and five journals/patent publications. If 41.73% of students underwent an internship/ industrial project and 75 % of students identified the industries in core, articulate good reports, and presented the work in an organized manner will give substantial attainment in internships/ industrial projects.

## 4. Conclusion

The assessment of program outcomes through students' co-curricular activities such as paper and project presentations and internships/ industrial projects is discussed. The rubrics-based assessment system gives transparent and accurate measurements of the selected activities. The average attainment percentage of all POs and PSOs is 93.9%, and POs 6 and 7 achieve 96%. POs 2,5,12 display 92.44 % of attainment, and PSO1 &PSO2 shows 94.33 %. The proposed method gives an in-view of the rubrics-based measurement of co-curricular activities for program outcomes PO1-PO12 as well as PSO1 and PSO2 and it measures the students' affective and psychomotor domains along with the cognitive domain.

## Acknowledgment

The authors are indebted to the department of EIE, Kongu Engineering College, for the support in the study.

## References

[1] Accreditation Manual For UG Engineering Programs (TIER-I)(2019). https://www.nbaind.org/files/UG%20-%20Tier%20I%20Manual.pdf.

[2] B. Pejcinovic, "Design of Rubrics for Student Outcomes in 2019-2020 ABET Criteria," 2020 43rd International Convention on Information, Communication and Electronic Technology (MIPRO), pp. 1543–1548, 2020.

[3] K. Y. Tshai, J.-H. Ho, E. H. Yap, and H. K. Ng, "Outcome-based Education – The Assessment of Programme Educational Objectives for an Engineering Undergraduate Degree," Engineering Education, vol. 9, no. 1, pp. 74–85, 2014.

[4] M. R. Jadhav, A. B. Kakade, S. R. Jagtap, and M.

S. Patil, “Impact assessment of outcome based approach in engineering education in India,” Procedia Computer Science, vol. 172, pp. 791–796, 2020.

[5] J. Mohanta and S. K. Das Mandal, "The Effectiveness of the Outcome-Based Curriculum Towards Improving Educational Quality for Technical Education," 2019 IEEE Tenth International Conference on Technology for Education (T4E), 2019, pp. 242-243, doi: 10.1109/T4E.2019.00-13.

[6] R. Nordin, A. A. Bakar, N. Zainal, and H. Husain, “Preliminary Study on the Impact of Industrial Talks and Visits towards the Outcome Based Education of Engineering Students,” Procedia - Social and Behavioral Sciences, vol. 60, pp. 271–276, 2012.

[7] T. Sasipraba, R. K. Bantha Navas, N. M. Nandhitha, S. Prakash, J. Jayaprabakar, S. P. Pushpakala, G. Subbiah, P. Kavipriya, T. Ravi, and G. Arunkumar, “Assessment Tools and Rubrics for Evaluating the Capstone Projects in Outcome Based Education,” Procedia Computer Science, vol. 172, pp. 296–301, 2020.

[8] R. A. Rahmat, “Achievement of Program Outcomes Using Assessment Plan,” Procedia - Social and Behavioral Sciences, vol. 18, pp. 87–93, 2011.

[9] P. Jayarekha and M. Dakshayini, "Programme outcomes assessment by direct method," 2014 IEEE International Conference on MOOC, Innovation and Technology in Education (MITE), 2014, pp. 264-267, doi: 10.1109/MITE.2014.7020285.

[10] H. F. Wahab, A. Ayob, W. M. Zaki, H. Hussain, A. Hussain, and S. S. Mokri, “Program Outcomes Measurement and Assessment Processes,” Procedia - Social and Behavioral Sciences, vol. 18, pp. 49–55, 2011.

[11] J. M. Zeeman, A. A. Bush, W. C. Cox, and J. E. McLaughlin, “Assessing the Co-Curriculum by Mapping Student Organization Involvement to Curricular Outcomes Using Mixed Methods,” American Journal of Pharmaceutical Education, vol. 83, no. 10, p. 7354, 2019.

[12] Liew, C. P., Puteh, M., Mohammad, S., Omar, A. A., & Kiew, P. L. (2020). Review of engineering programme outcome assessment models. European Journal of Engineering Education, 1–15. https://doi.org/10.1080/03043797.2020.1852533

[13] Liew, Chia Pao, Marlia Puteh, Shahrin Mohammad, Abdul Aziz Omar, and Peck Loo Kiew. "Review of engineering programme outcome assessment models." European Journal of Engineering Education 46, no. 5, 834-848, 2021.

[14] Matthews, Megan E., Ani Avoundjian, Dalia Ameripour, Whitney Fakolade, Maryann Wu, and Ian S. Haworth. "Assessment of the impact of co-curricular activities on achievement of Doctor of Pharmacy program outcomes." Currents in Pharmacy Teaching and Learning 14, no. 4, 440-448, 2022.

[15] Amirtharaj, S., G. Chandrasekaran, K. Thirumoorthy, and K. Muneeswaran. "A Systematic Approach for Assessment of Attainment in Outcome-based Education." Higher Education for the Future 9, no. 1,pp. 8-29,2022

[16] “Examination Reform Policy - aicte-india.org.” https://www.aicte-india.org/sites/default/files/ExaminationReforms.pdf. 2018.