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Integrating Activity Outcome into an Outcome Based Assessment Framework and Development of an Excel Computational Tool: A SoTL Approach

Sunil Job K. A¹, Joby Cyriac²

¹ Associate Professor, Marian College Kuttikkanam, Autonomous, Kerala, India

² Assistant Professor, Marian College Kuttikkanam, Autonomous, Kerala, India

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Abstract

Assessment of students with respect to the learning outcome is of vital importance for ensuring the level of attainment of learner in terms of Course level outcomes and Program level outcome in the context of Outcome Based Education. For an inclusive assessment of these outcomes, it is essential that the activity outcome related to various clubs, forums and other extension activities should be effectively integrated with the assessment process. These multifarious activities create a real platform for experiential learning. Hence combining all the activities related to Sports, Arts and Extension will be indispensable for an overall development of learner, enhancing student engagement and scaling the attainment of desired learning outcome. Integration of the Activity Outcome with the Program level outcome posed a number of challenges due to the higher level of flexibility and autonomy of the learner in selecting the pathway of learning. In this paper we have attempted to suggest a framework where we could generate a program matrix based on students' choice of options with respect to the curricular and extracurricular activities from a program level grid, and standardization of the assessments with respect to the predetermined threshold number of indicators to ensure the level of attainment of the outcomes. An excel based automated tool is also developed using the computation algorithm and its efficiency is tested using a Scholarship of teaching and learning (SoTL) approach by validating its practicability and usability among the peer instructors. The results of the analysis of the responses from the stakeholders / peer instructors seems to be very encouraging. Very high positive means with respect to effectiveness, usage and satisfaction level among the peer evaluators indicate stakeholders' confirmation of the assessment strategy and effectiveness of the developed tool.

Keywords: - Scholarship of Teaching and Learning (SoTL), Program Outcomes POs, Program Specific Outcomes PSOs, Activity Outcome AOs, Component Activity Outcome CAO, Outcome Mapping, Mapping Threshold.

I. INTRODUCTION

The evolving scenario of higher education have witnessed a drastic change in its approach and practices. The paradigm shifts from traditional objective based to outcome based have Posed a number of challenges among the stakeholders in the higher education sector. One major challenge in the implementation of outcome-based education is the assessment of the attainment of outcome when the students are given flexibility in the selection of diverse courses and activities. Moreover, as per the latest curriculum revision the students are given autonomy to select multidisciplinary course of study in various pathways according to their choice. In this context a standardized program matrix for the estimation of the Program Outcome is not possible. Furthermore, diversification of curriculum and inclusion of multiple activities and experiential learning opportunities is considered as valuable avenues for fostering all-round development and porting the learning experiences to higher order thinking skills. Hence for a successful implementation of Outcome Based Education it is important to develop a framework that could accommodate various activity outcomes and the flexibility of the student's choice in computation of the level of attainment of Program outcomes.

Besides it has become imperative to have a tool by which we could lessen the effort of documentation and calibration of the activity outcomes and integrating it with the direct assessment for the estimation of Program Outcomes.

This study seeks to identify a feasible approach for computation of the attainment of activity outcome and to integrate it with direct assessment in the OBE process. A SoTL based approach is considered as a better way to develop a model and to ensure its practicability and effectiveness in estimation of outcomes within the framework of outcome-based education.

To ensure a scholarly and comprehensive study on Outcome-Based Education (OBE) within the higher education institution (HEI) context, various scholarly works and journals have been consulted, both from Indian and global perspective. For a complete understanding of the possibilities the following resources are utilized.

Singh and Sachdeva's (2019) examination of Outcome-Based Education implementation and perspectives in the Indian context, focusing on assessment practices tailored to OBE frameworks.

Pai and Adiga's (2017) primer on Outcome-Based Education practices within India, offering insights into curriculum design, assessment methods, and their alignment with industry requirements, particularly focusing on assessing activity outcomes.

Chandrasekhar and Ramaswamy's (2016) examination of Outcome-Based Education implementation and assessment strategies, particularly emphasizing the assessment of activity outcomes and their integration with direct assessment methods within Indian educational settings.

Nair and Paul's (2015) handbook on Outcome-Based Education assessment strategies, which discusses various techniques aligned with OBE principles, including assessing activity outcomes and integrating them with direct assessment methods.

Additionally, globally notable works such as:

Biggs and Tang (2011), who advocate for constructive alignment in teaching, emphasizing the alignment of intended learning outcomes, teaching activities, and assessment tasks, thus highlighting the importance of assessing activity outcomes within an OBE framework.

Boud and Falchikov's (2006) review on aligning assessment with long-term learning goals, providing strategies for assessing activity outcomes and integrating them with direct assessment methods to foster deep learning and meaningful student engagement within an OBE framework.

Wiggins and McTighe's (2005) seminal work on Understanding by Design (UbD), stressing the significance of designing curriculum and assessments based on desired learning outcomes, thus offering insights into aligning assessments with activity outcomes and integrating them within the OBE framework.

Knight and Yorke's (2003) exploration of the nexus between assessment, learning, and employability, underscoring the importance of assessing activity outcomes within an OBE framework and integrating them with direct assessment methods to enhance student employability skills.

1.1. Research Questions

The purpose of this SoTL study is to develop a framework of integrating multifarious activities related to curricular and extracurricular in the computation of Program Outcomes. The study focuses to direct the instructors in the following aspects

- How can activity outcomes be effectively integrated into the existing OBE framework for comprehensive program outcome computation?
- How do different types of activity outcomes (e.g., club participation, arts engagement, sports involvement, extension activities) contribute to the attainment of program-level outcomes?
- What strategies and best practices can be implemented to facilitate the integration of activity outcomes into the assessment framework of OBE for program outcome computation?
- Development of an automated tool in excel for the documentation and calculation of Activity Outcome with automated reports on Attainments of Outcomes
- Opinion from the stakeholders (teachers) regarding the assessment strategy and the excel based automated tool adopted in computation of Activity Outcomes and their views regarding the integration of the activity outcome with the assessment of POs and PSOs.

II. PROPOSED FRAMEWORK FOR ACTIVITY OUTCOME ASSESSMENT

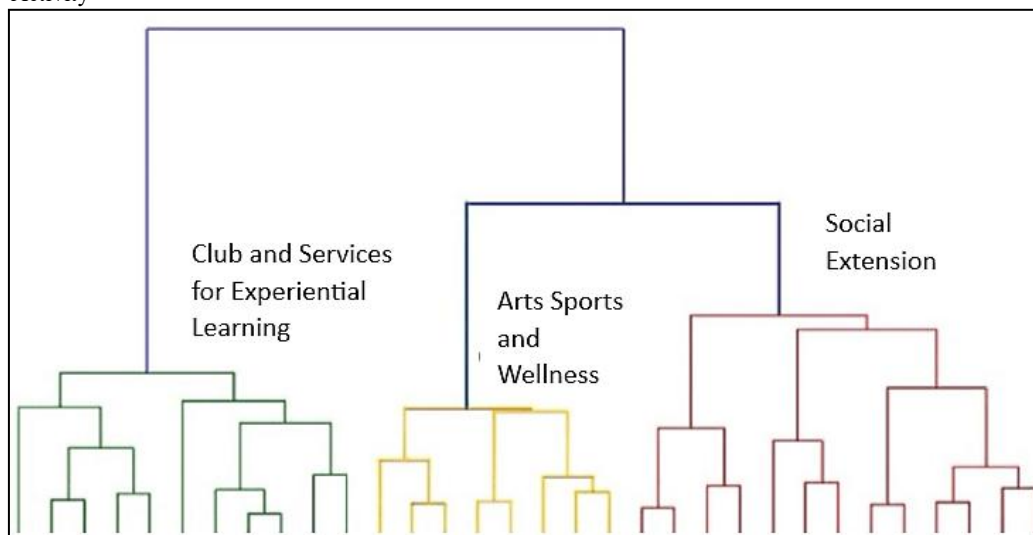
2.1. Key Principles of the Framework

- Assessments applicable to all type of curricular and extra-curricular activities
- Data to be tracked from continuous monitoring and documentation with respect to all activities considered for assessment
- Assessment rubric to evaluate and score students' performance in terms of level of participation is done.

2.2. Activity Clustering

In order to bring diversity in the participating activities by the students, it will be good practice to Bin the club related (Clustering) or other cocurricular and extracurricular activities into various Bins that have some common characteristics and ensure students participation from every Bins. A suggestive way of binning the activities as detailed below can be done using a dendrogram as given below. Here the 3 Bins or activity Cluster could be paired in terms of Competency enhancement, fitness and well being and social extension

Fig 1: Dendrogram for clustering of various activities into Clubs, Art & Sports and Social Extension related Activity



2.3. Activity Outcome mapping to POs and PSOs

The various activity outcomes related to Club and Services, Arts – Sports and wellness and Social Extension activities should be mapped with the respective POs and PSOs in a binary scale of whether it addresses or not. The mapping matrix could be designed as in Table 1.

Table 1: Matrix of Mapping of AO1 and its component Activity Outcomes to respective POs and PSOs

AO ₁	PO ₁	PO ₂	PO ₃	PO ₄	PO ₅	PO ₆	PO ₇	PO ₈	PSO ₁	PSO ₂	PSO ₃
AO1.1	1			1			1			1	
AO1.2	1	1					1				
AO1.3		1		1					1		
AO1.4	1								1		
AO1.5		1		1						1	
AO ₁	1	1		1			1		1	1	

Here AO1.1, AO1.2.....AO1.5 are outcome related to the various activity conducted by the Clubs/forums. The cells with 1 indicate that the Activity (the outcome corresponding to the specific activity) is related to the respective POs and PSOs. On consolidation of the mapping of the component activities (outcomes) to an overarching parent outcome AO₁, we shall consider that AO₁ as equally addressing the PO₁, PO₂, PO₄, PO₇, PSO₁ and PSO₂. This consolidation of the number of activity outcome to a parent Activity outcome related to the club or forum could reduce the complexity of calculation and representation of the Activity Outcome.

2.4. Assessment Rubrics

For standardization of the assessment of various activities and to have a uniform assessment pattern we can adopt the following rubrics to score the performance and involvement of the participants in related activities. This rubric could be altered as per the norms and policies of the institution

Table 2: Assessment Rubrics indicating the various level of performance and involvement of students related to various activity and the corresponding scores they gain.

Level of participation	Description	Score
Level 0	Non-Participation and non-involvement	0
Level 1	Participation in the events	1.5
Level 2	Organizing of the event	2
Level 3	Winning of any events at college level	2.5
Level 4	Winning at intercollege level and above	3

2.5. Computation of Activity Outcomes

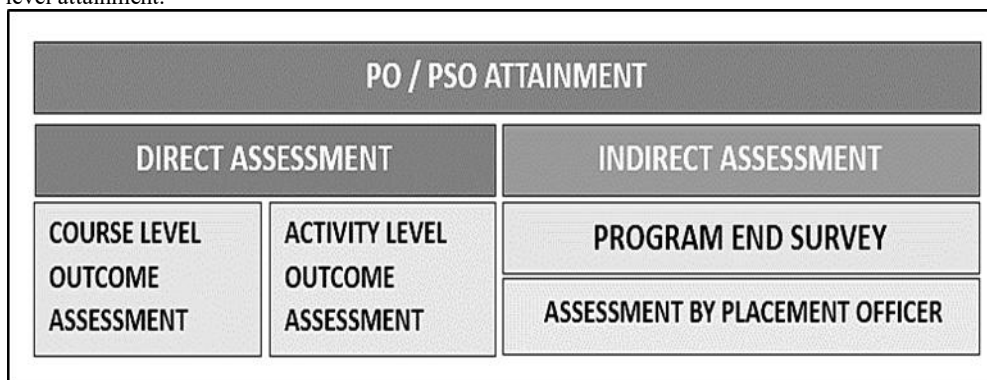
AO attainment will be calculated at the end a year (2 semester). A minimum number of Activities related to any club/sports/social extension may be fixed say (5 Activities). The performance of the student with respect to each activity is assessed using the standardized rubrics and documented.

- Attainment of AO1 with respect to a student = Average of the attainment of the student with respect to various activities (activity 1 to activity 5) could be considered as a measure of the level of attainment of that Activity Outcome.

2.6. Integration of Activity outcomes to POs and PSOs

The attainment scores of the AO₁ could be transferred to all the POs that the component outcomes of AO1 addresses with an equal weightage. In table 1, AO₁ is addressing PO₁, PO₂, PO₄, PO₇, PSO₁ and PSO₂. In this case the attainment score of AO₁ can be equally distributed to all these Program Outcomes. For the final estimation of the POs and PSOs in order bring a standardization to the calculation process a threshold (a minimum number of scores needed to make the POs and PSOs mature for estimation of the final Program Outcomes) may be pre-defined.

Fig 2: Schematic representation of the assessment process that led to the computation of the POs/PSOs level attainment.



- Attainment Score of POs (Direct Assessment) = Average of (Top scoring, threshold number of COs/AOs that are connected to the corresponding POs/PSOs)

3. DEVELOPMENT OF EXCEL BASED COMPUTATIONAL TOOL

An excel based prototype calculation engine based on the framework detailed in this paper is developed to facilitate the attainment calculation of Activity Outcome. This model offers an easy-to-use interface and an authentic computation system for calculation of the activity outcome attainment and distributing the AO component to the various POs to which the activity is related.

3.1. Data entry

The model has separate interfaces to document student data, Activity Outcomes and its component outcomes, binary mapping of the component outcomes to the respective POs and the mark entry page to document the level of involvement of students in various activity as per the rubrics.

3.2. Algorithms

The model uses the appropriate algorithms and statistical technique as detailed in this paper for computation of Activity Outcomes scores. The model provides flexibility to customize the calculation procedure in accordance with the requirement of various assessment practices.

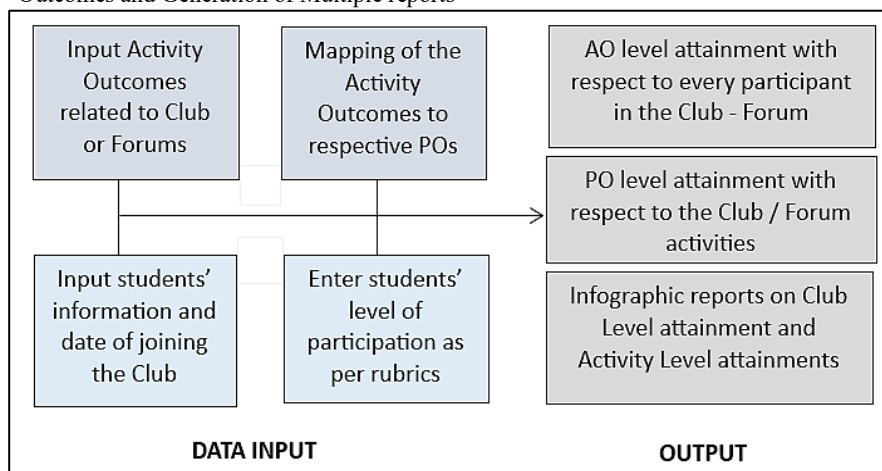
3.3. Analytics

The model calibrates the attainment of the students and generates report to showcase the attainment of the class with respect to various Activity Outcome. The mapping of the activity outcomes to the respective POs in a binary format is integrated with this model, hence we get a student wise distribution of the attainment scores with respect to the various POs to which the Activity Outcome is related. This helps the user to integrate the Activity outcome attainment with the other Course level attainment in calculation of the final attainment score of POs and PSOs. Moreover, we have reports on club wise performance with respect to each activity and the average performance level in each activity and distribution of the students with respect high, moderate and low level of performance and involvement in the activity.

3.4. Customization

The model could be customised to various scale in par with the requirement of the stakeholders and assessment scenario. The calculation algorithms and the nature of the reports can also be customised to the specific requirement of the user.

Fig 3: Process flow of the Excell based automated model for estimation of Activity Outcomes and Generation of Multiple reports



IV. STAKEHOLDER VALIDATION THROUGH SoTL APPROACH

The mean score of the response for each statement based on the Likert scale from the group of 63 club conveners who used the tool for the computation of AO is collected. The category of response is scored with a weightage of 1 to 5 from negative to positive and the summary of the analysis is given in the table 3

Table 3: The mean score of the opinion of the stakeholders towards the various statement towards the usage of the Excel tool for computation of Activity Outcomes.

Statements from Questionnaire	Mean
To what extent did you find the features of the Excel-based tool helpful in facilitating the assessment process?	4.14
How effectively did the Excel-based tool generate reports and visualizations to interpret assessment data and identify trends?	4.27
To what extent do you believe that the Excel-based assessment tool aligns with the objectives and outcomes of the assessments?	4.1
How confident are you in the validity of the assessment data generated by the Excel-based tool?	4.24
How confident are you in the reliability of the assessment data generated by the Excel-based tool?	4.32
How would you rate the overall usefulness and value of the Excel-based assessment tool in assisting you with student assessment and analysis?	4.32
Overall, how satisfied are you with the Excel-based assessment tool?	4.22
How user-friendly did you find the Excel-based assessment tool for entering student assessment data and conducting analysis?	4.37
How clear and comprehensive were the instructions and guidance provided with the Excel-based tool for conducting assessments?	4.21
How likely are you to recommend the Excel-based assessment tool to other teachers or colleagues for use in their assessment practices?	4.38

Analysing the responses of the various club conveners it is found that the average score of all responses is much higher than the neutral response score of 3. This indicates that there is a very high level of positive response towards the model among conveners of various clubs and activities.

Further on clustering these Statements in terms of Effectiveness, Satisfaction and Usability, the mean score of the observation is given in table 4.

Table 4: The mean score of the opinion of the stakeholders when aggregated in terms of various criteria namely Effectiveness, Satisfaction and Usage

Sl. No	Criteria	Mean
1	Effectiveness	4.17
2	Usage	4.32
3	Satisfaction	4.28

On analysis of the responses with respect to various category – Effectiveness, Usage and Satisfaction it is observed that the average score of response of the stakeholders with respect to the category Effectiveness, Usage and Satisfaction are 4.17, 4.32 and 4.28 respectively and is much higher than the neutral response score of 3. This indicates that the opinion of the opinion of the stakeholders towards the automated tool with respect to the foresaid criteria are fairly high.

Furthermore, the correlation coefficient of each pair of items within each category is calculated to ascertain the internal consistency and validity of the responses within the category.

Table 5: Correlation Coefficient of the statement related of (Efficiency)

Items	1	4	9
1. How user-friendly	1		
4. How clear and comprehensive	0.891	1	
9. How likely to recommend	0.954	0.885	1

Table 6: Correlation Coefficient of the statement related of (Usage)

Items	3	6	7
3. How effective reports	1		
6. Confidence in validity	0.901	1	
7. Confidence in reliability	0.956	0.896	1

Table 7: Correlation Coefficient of the statement related of (Satisfaction)

Items	2	5	8	10
2. How helpful features	1			
5. Alignment with objectives	0.981	1		
8. Overall usefulness	0.957	0.965	1	
10. Overall satisfaction	0.881	0.938	0.889	1

In all of the above table 5, table 6 and table 7 The correlation coefficient with respect to pair of items within each category is much high indicating that all the items within the category are consistent and the response of the conveners are valid.

V. RELIABILITY ANALYSIS OF THE QUESTIONNAIRE

Cronbach's alpha for each category namely usage, efficiency and satisfaction are computed by calculating the variance of each item within the category and the total variance across all items and by applying the Cronbach's alpha formula.

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_i^2}{\sigma_x^2} \right)$$

The calculated value of Cronbach alpha for ensuring the reliability of the questionnaire is given is table 8

Table 8: Cronbach alpha for the usage, efficiency and satisfaction

Subcategory	N	Items	Cronbach's alpha
Efficiency	63	3	0.942
Usage	63	3	0.917
Satisfaction	63	4	0.871

It is found that for the Category Efficiency and Usage the Cronbach's alpha value is much high above 0.9 which is a very excellent value which indicating that the tool is highly reliable in estimate of Efficiency and Usage. Also, that the Cronbach's value for Satisfaction is 0.871 which also fair value showing a high level of consistency for the criteria satisfaction.

VI. DISCUSSION

The primary focus of this study is to suggest a framework for assessment of activity outcomes and integration of diversified activity outcome into the computation of Program Outcomes. The main challenge in this regard is that due to flexibility in selection of the various club related activity a standardized program matrix for a program cannot be prepared. In this study we have suggested a program grid that accommodate all set of activities and courses irrespective of open or elective to be listed in the program grid. For the computation of PO level attainment of each student a dynamic student level program matrix should be generated (as per the pathway adopted by the student in his course of study). For standardization of the computation of POs and PSOs a threshold that is a benchmark that declares a minimum number of activities or course outcomes that is necessary for the calculation of program level outcomes. By the tenure of his study the student should ensure that his program matrix (as per his selected pathway) meet the minimum essential requirement as per the threshold fixed for each program level outcomes.

Comprehensiveness of the assessment and inclusiveness of all the Activity Outcome component into the computation of POs and PSOs, it is suggested that the major outcome related to the club or forums may be further subdivided into component outcomes and map these component outcomes to the overarching program outcomes in a binary scale (whether it address or not) of 1 or 0. Further we could combine all the component outcomes mapping to a single line mapping which showcase the mapping of the parent Activity Outcome to the respective POs

A club can organize any number of activities, for each activity the level of participation of each student of the club should be assessed in line with the standardized rubric to gauge the performance and participation of the students. The rubric can be prepared a per the norms and standards identified by the college. The average score of performance of the students

across various activities is considered as the AO level attainment and it will be equally distributed to all POs and PSOs that the Parent AO addresses. For facilitating the documentation and calculation of the outcome we have developed a excel based tool customized in line with the algorithm for computation of Activity Outcome.

For validation of the process and the developed tool, stakeholders' opinion is collected through peer review and by administering a questionnaire focusing on efficiency, usage and satisfaction of the system. The high positive mean scores for each questionnaire item and very high average scores across effectiveness, usage, and satisfaction indicate strong stakeholder endorsement towards the assessment framework and the developed tool.

The high correlation coefficients and Cronbach's alpha values within the subcategories of effectiveness, usage, and satisfaction demonstrate the internal consistency and reliability of the questionnaire.

In conclusion, this study offers a significant contribution to the assessment of Outcomes in an OBE scenario. The rigidity of the traditional framework by considering a standardized program matrix can be replaced by much more practical and flexible assessment procedure by developing a program grid and dynamic student-centred program matrix according to the selected pathway of study. Moreover, an evidence-based approach (SoTL) was adopted to gauge the practicability and efficiency of the suggested framework and the developed tool in providing a workable solution in the outcome-based assessment process.

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