

# Crafting a TOPSIS-Based Formative Assessment Solution for Financial Management Course Among Non-Accounting Undergraduates

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**Abstract** – This research investigates the impact of various pedagogical strategies on the learning performance of non-accounting major students, with a focus on the flipped classroom model. The study reveals that interactive teaching between educators and students emerges as the optimal solution, emphasizing the need for dynamic and participatory teaching methods to encourage active engagement. Additionally, the research suggests the importance of enhancing student group presentations to foster collaborative learning experiences. Furthermore, the study challenges traditional assessment methods, specifically highlighting term reports as the least effective option for stimulating students' interest in learning. The findings advocate for educators to reconsider assessment approaches, exploring alternatives aligned with students' preferences and engagement levels. While the new teaching formative assessment solution is well-received, addressing lower confidence in future career prospects signals the need for integrating practical elements into the curriculum and providing career counselling to boost students' confidence in their professional endeavours.

**Keywords** – Formative assessment, pedagogical strategies, learning performance, interactive teaching.

## 1. Introduction

Currently, the educational panorama has witnessed substantial transformations. The incorporation of instructional platforms, virtual classroom settings, and mobile learning tools illustrates how educators and learners adopt evolving technologies [1]. Nevertheless, despite ongoing progress in pedagogy and technology, the existing university education system predominantly relegates students to passive roles, impeding the cultivation and enhancement of fundamental skills essential for professional environments [2], [3]. The conventional model of teacher-led instruction with students as passive absorbers no longer aligns with contemporary requirements. Moreover, prompted by the repercussions of the COVID-19 pandemic, education has shifted to an online format, compelling educators to explore methods that replicate the effectiveness of traditional classroom teaching in the online environment [4], [5]. Crucially, fostering genuine inspiration among students throughout the learning process, while simultaneously gauging learning effectiveness, has emerged as a pertinent concern for educators, irrespective of whether teaching is conducted offline or online.

A novel instructional approach, the "flipped classroom," has surfaced. In this model, instructors furnish students with pre-established digital materials via external platforms, delivering asynchronous content related to the course outside the conventional classroom setup. Students prepare by reviewing pre-recorded lectures or assigned readings before participating in classroom activities such as interactive engagement, just-in-time teaching, and peer guidance [6].

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However, at every juncture where teachers execute instructional objectives, adhere to the teaching syllabus, and conduct teaching evaluations, effectively and comprehensively assessing students' learning outcomes remains a significant challenge, crucial for evaluating the efficacy of course instruction [7]. Sadly, while there is an abundance of literature delving into novel forms of blended teaching, there is a need for more studies addressing the development of comprehensive and pragmatic solutions for evaluating learning effectiveness within the blended flipped classroom teaching model. Hence, this article, by outlining the selection process and outcomes of student learning effectiveness assessment schemes in university economics and management course teaching, underscores the significance of choosing suitable assessment approaches. It also aims to inspire ideas and prompt future researchers to delve deeper into this subject for more comprehensive exploration and discussion.

The structure of this paper is as follows: The next section provides a concise overview of the TOPSIS method, addressing the practical learning effectiveness assessment issue in the context of a multiple-attribute decision-making problem. Following that, the TOPSIS method is applied to determine a new assessment solution for the study, incorporating descriptive statistical analysis to examine variations in college student satisfaction based on the proposed solution. The ensuing section discusses the findings derived from the survey results. Ultimately, conclusions are drawn in the final section.

## 2. Teaching Formative Assessment

Formative assessment in teaching involves making real-time adjustments to observe students' progress in their learning journey, allowing teachers to continuously monitor and provide immediate feedback throughout the teaching process [8]. This ongoing feedback, cited by Stanja *et al.* [9], serves as a valuable reference for teachers to make timely adjustments to teaching plans and enhance methods as needed.

Essentially, formative assessment evaluates students' daily learning processes, achievements, and the dynamic aspects of their emotions, attitudes, and strategies. It revolves around a comprehensive assessment of the entire student learning journey through continuous observation, recording, and reflection, with the primary goal of inspiring active student engagement, effective self-regulation, and the development of a sense of accomplishment, self-confidence, and a collaborative spirit [10].

In teaching practice, formative assessment during the teaching process centers on interactive teaching between teachers and students, encouragement of students' self-directed learning, group presentations by students, and semester learning reports [11]. While these aspects are crucial for formative assessment, their emphasis varies across different subjects. Practical scenarios often reveal situations where subjects considered core courses for Department A may hold a different status for Department B or C, particularly in the context of common majors in the college teaching plan. Therefore, the assessment process should consider various dimensions, avoiding a one-size-fits-all approach.

To attain this objective, the study opted for "Financial Management," a compulsory course for majors in the School of Economics and Management at a specific university, as its focal point. The aim is to investigate how university subject committees can employ effective and scientifically grounded decision-making methods to ascertain the proportion of formative assessment for courses catering to majors outside the realm of accounting. Over two semesters of field observations, this study aspires to uncover students' perspectives on the fairness and satisfaction associated with learning assessments. The intent behind the research findings is to encourage additional discussions on pertinent topics in the future.

## 3. TOPSIS: Selecting an Appropriate Solution with a Simple Way

In contrast to the "top-down" command approach commonly observed in enterprises, the internal deliberations on management plans within different academic departments of colleges and universities seem to embrace more diversity. Within a professional-oriented environment, each discipline may encompass various perspectives, leading to a prolonged decision-making process. As a significant decision-making technique, the Delphi method finds widespread application in various domains, including politics, economics, society, and technology. Characterized as a "structured expert group communication process for solving decision-making problems" [12], the Delphi method involves participants in a panel discussion sharing their opinions, knowledge, or experiences. This approach facilitates spontaneous processes guided toward a defined direction across multiple meetings and surveys, resulting in a practical option rather than the singular 'best' or 'optimal' solution. However, due to its reliance on extensive discussions, the Delphi method is time-consuming and is criticized for its uncertain forecast accuracy [13].

It is essential for solution planning to adopt a holistic approach, as excessive attention to specific details may lead to losing sight of overarching priorities. The Delphi method's decision-making process tends to emphasize the acquisition of a 'definitely viable option excessively.'

Drawing on Hwang and Yoon's work [14], the TOPSIS method is expounded upon in Chen and Hwang [15]. The fundamental principle is that the selected alternative should be the closest to the ideal solution and the farthest from the negative ideal solution. The TOPSIS procedure encompasses the following six steps:

(1) Compute the normalized decision matrix. Determine the normalized value  $r_{ij}$  using the following calculation:

$$r_{ij} = f_{ij} / \sqrt{\sum_{j=1}^J f_{ij}^2} \quad j=1, \dots, J; i=1, \dots, n.$$

(2) Compute the weighted normalized decision matrix. Determine the weighted normalized value  $v_{ij}$  using the following calculation:

$$v_{ij} = w_i r_{ij}, \quad j=1, \dots, J; i=1, \dots, n, \quad (1)$$

where  $w_i$  is the weight of the  $i$ th attribute or criterion and  $w_i = 1$ .

(3) Determine the ideal and negative-ideal solution.

$$A^* = \{v_1^*, \dots, v_n^*\} \\ = \left\{ \left( j \max v_{ij} \mid i \in I^+ \right), \left( j \min v_{ij} \mid i \in I^- \right) \right\}$$

(2)

$$A^- = \{v_1^-, \dots, v_n^-\} \\ = \left\{ \left( j \min v_{ij} \mid i \in I^+ \right), \left( j \max v_{ij} \mid i \in I^- \right) \right\}$$

(3) where  $I^+$  is associated with benefit criteria and  $I^-$  is associated with cost criteria.

(4) Compute the separation measures using the  $n$ -dimensional Euclidean distance. The separation of each alternative from the ideal solution is determined as:

$$D_j^* = \sqrt{\sum_{i=1}^n (v_{ij} - v_i^*)^2}, \quad j=1, \dots, J. \quad (4)$$

Similarly, the separation from the negative-ideal solution is given as

$$D_j^- = \sqrt{\sum_{i=1}^n (v_{ij} - v_i^-)^2}, \quad j=1, \dots, J. \quad (5)$$

(5) Calculate the relative closeness to the ideal solution. The relative closeness of the alternative  $a_j$  with respect to  $A^*$  is defined as

$$C_j^* = \frac{D_j^-}{(D_j^* + D_j^-)}, \quad j=1, \dots, J. \quad (6)$$

(6) Finally, rank the preference order.

#### 4. Applying TOPSIS for Optimal Formative Assessment Solution Selection

The School of Economics and Management at Public University A is home to approximately 1,850 students, spanning departments such as Accounting, International Trade, Marketing, and Logistics Management. Financial management subjects constitute compulsory courses for various majors. Over time, the academic affairs department at University A has observed significant disparities in student learning outcomes and teaching evaluations for financial management subjects across departments. Notably, the Department of Accounting stands out with notably high effectiveness and teaching evaluations, while responses from other departments range from mediocre to low levels in comparison.

To address and improve this situation, encouraging tremendous enthusiasm among non-core major students to engage with mandatory professional courses and enhance their learning effectiveness, the subject committee of University A has not only implemented the flipped classroom teaching method but also extensively discussed the proportion of formative evaluation in teaching. Following deliberations, the subject committee introduced four new evaluation options: interactive teaching between educators and students, promotion of student independent learning, student group presentations, and semester learning reports. These options were formulated to assess the quality of economic and management subjects in the non-accounting department, guided by students' course assessment methods. Subsequently, the committee revised the teaching syllabus and carried out essential tasks, including the formulation of lesson plans and teaching schedules, based on the major formative assessment solution being confirmed.

In the weight evaluation of each standard at this stage, the relevant decision-making experts involved are members of the subject committee of University A, directors of subject committees of foreign universities, and leaders of education authorities.

In this context, the ultimate selection was made by experts, taking into consideration the teaching scenario at the School of Economics and Management of University A and the satisfaction derived from students' teaching evaluations (Figure 1).

The assessment criteria for evaluating the effectiveness of proposed solutions in enhancing the learning performance of non-accounting major students in Financial Management are structured around six key dimensions. The first dimension, engagement and participation, emphasizes the active involvement of students in the learning process. It entails assessing the level of interaction during interactive teaching sessions, students' commitment to independent learning, and their active participation in group presentations. This criterion prioritizes creating a dynamic and participatory learning environment that fosters engagement. The second dimension, Comprehensive Understanding, delves into the depth of comprehension students achieve in Financial Management concepts. This evaluative measure aims to gauge the extent to which students showcase a profound understanding through interactive teaching, independent learning pursuits,

and their contributions to group presentations. It seeks to measure the efficacy of the proposed solutions in facilitating a thorough grasp of the subject matter, thereby promoting meaningful and holistic understanding.

Additionally, communication skills focus on assessing students' proficiency in articulating and presenting ideas effectively. This criterion evaluates the quality of communication demonstrated during interactive teaching sessions, the expression of independent learning, and the clarity of ideas presented in group sessions. Effective communication is recognized as a pivotal skill in conveying complex financial concepts, making this dimension integral to the overall evaluation process.

The remaining three dimensions encompass critical thinking and problem solving, self-regulation, and feedback and reflection, each contributing essential perspectives to the comprehensive evaluation framework. These dimensions collectively provide a nuanced and thorough approach to assessing the impact of proposed solutions on the learning performance of non-accounting major students in financial management.

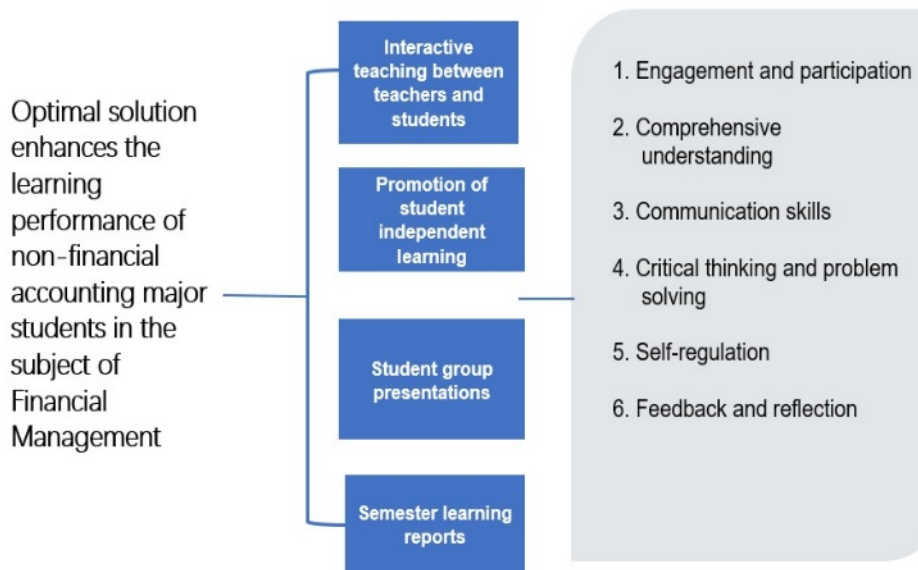


Figure 1. Evaluation of hierarchical structure for new policy solution selection

Table 1 presents the raw data for each indicator, primarily assessed through the historical classroom performance and accomplishments of non-accounting majors in economics and management.

Put differently, the initial data originates from both students' academic performance and teachers' teaching evaluations, possessing a certain degree of reciprocity and impartiality.

Table 1. Collected data from each criterion

Criteria	Teaching formative assessment solution			
	Interactive teaching between teachers and students	Student independent learning	Student group presentations	Semester learning reports
Engagement and participation	87.6	84.5	85.3	79.4
Comprehensive understanding	84.2	88.1	86.7	83.8
Communication skills	90.4	89.7	91.7	87.6
Critical thinking and problem solving	93.4	88.4	90.6	86.7
Self-regulation	92.4	82.6	87.8	84.9
Feedback and reflection	93.5	86.8	91.8	83.4

The experts evaluated the subjective relative importance of each criterion through a comprehensive interview using a pair-wise questionnaire. Experts generally believe that the frequency and effectiveness of two-way interaction between teachers and students stand out as the most crucial criteria for the selection of teaching evaluation. This finding can be attributed to the historical attitudes of previous students towards teaching evaluations, particularly in the domain of

critical thinking and problem solving. Furthermore, the assessment of student group reports necessitates consideration of communication skills, engagement, and participation. This implies that more than conventional teaching approaches and outcome-based evaluations are needed to capture the interest of non-accounting major undergraduates in the learning process. Table 2 shows the weighted normalized decision matrix used by Eq. (1).

Table 2. Normalized matrix

Solution	Criteria					
	Engagement and participation	Comprehensive understanding	Communication skills	Critical thinking and problem	Self-regulation	Feedback and reflection
Interactive teaching between teachers and students	0.074	0.071	0.054	0.052	0.089	0.016
Student independent learning	0.062	0.059	0.045	0.025	0.065	0.011
Student group presentations	0.067	0.070	0.068	0.009	0.072	0.024
Semester learning reports	0.055	0.046	0.025	0.035	0.035	0.088

The TOPSIS ranking lists generated through Eq. (6) are displayed in Table 3, revealing that interactive teaching between teachers and students emerges as the optimal solution for non-accounting major students. Additionally, it underscores the importance of enhancing the proportion of student group presentations in improving students' learning performance. When it comes to submitting term reports, it is regarded as the least likely option to spark students' interest in learning.

Table 3. TOPSIS ranking results

Solution	Rank	Index
Interactive teaching between teachers and students	1	0.684
Student independent learning	3	0.479
Student group presentations	2	0.592
Semester learning reports	4	0.433

### 5. Results of Descriptive Analysis

To compare student satisfaction differences between non-accounting departments where the new teaching formative assessment was either implemented or not, a survey was conducted one year after the initiation of the new solution on September 1, 2023. The researchers administered 700 questionnaires in person. Unwilling respondents and invalid responses were excluded, resulting in 666 valid interviewees (n = 666, approximately 95.14%) for this study. During the pre-test stage from June 15 to 22, 2023, each sub-dimension was formulated based on respondents' opinions. The assessment of the learning experience in financial management comprised four key components: teaching satisfaction, scoring impartiality, knowledge development, and confidence in future career prospects. A Likert 1-to-5 rating scale (1 = strongly disagree to 5 = strongly agree) was employed for the survey. Rigorous questionnaire construction ensured internal consistencies for each survey item, maintaining reliability and validity above the normal threshold (Cronbach's alpha value = 0.73). The KMO value is 0.25, and the Bartlett test is significant (p<0.001) in this survey, attesting to the appropriateness of the data for factor analysis. Each survey item reflected a comprehensive list of selected topics, and their distribution significantly varied at a 5% significance level.

As shown in Table 4 and 5, the new teaching formative assessment solutions are positively received by non-accounting major students. Teaching satisfaction, in particular, stands out as the most acknowledged aspect among student respondents, with 89% expressing satisfaction on average.

However, it is noteworthy that confidence in future career prospects, while still relatively substantial, registers a lower percentage compared to the other dimensions, with 65% of respondents expressing confidence in this aspect.

Table 4. New teaching formative assessment solution survey result: Teaching satisfaction and scoring impartiality (n=666)

	Teaching satisfaction		Scoring impartiality	
	Satisfied	Unsatisfied	Satisfied	Unsatisfied
Dept. of Logistics Mgt. (n <sub>1</sub> =212)	93% (197)	7% (15)	68% (145)	32% (67)
Dept. of Marketing (n <sub>2</sub> =231)	86% (199)	14% (32)	78% (181)	22% (50)
Dept. of Int'l Trade (n <sub>3</sub> =223)	88% (196)	12% (27)	65% (145)	35% (78)

Table 5. New teaching formative assessment solution survey result: Knowledge development and confidence in the future career (n=666)

	Knowledge development		Confidence in the future career	
	Satisfied	Unsatisfied	Confidence	No confidence
Dept. of Logistics Mgt. (n <sub>1</sub> =212)	71% (151)	29% (61)	65% (138)	35% (74)
Dept. of Marketing (n <sub>2</sub> =231)	78% (180)	22% (51)	72% (166)	28% (65)
Dept. of Int'l Trade (n <sub>3</sub> =223)	72% (161)	28% (62)	58% (129)	42% (94)

### 6. Implications

This section comprises three key segments. Firstly, it delineates the significance of interactive teaching for non-accounting major students, emphasizing the necessity for dynamic and participatory pedagogical strategies. Secondly, the research suggests educators explore alternative approaches to better align with the preferences and engagement levels of non-accounting major students. Lastly, the positive reception of the new teaching formative assessment solution highlights the importance of addressing lower confidence in future career prospects by incorporating practical elements that connect classroom learning to real-world applications and career pathways, emphasizing the role of career counseling and guidance programs in enhancing students' confidence in their future professional endeavors. These insights contribute to a more comprehensive understanding of the multifaceted challenges and opportunities in tertiary education curriculum decision-making processes.

### **6.1. Pedagogical Strategies for Engagement**

The research findings bring to light the pivotal role of interactive teaching in optimizing learning outcomes for non-accounting major students. This underscores a critical need for educators to reassess and refine their pedagogical approaches. The study emphasizes the effectiveness of dynamic and participatory teaching methods in fostering active engagement, challenging traditional notions of passive learning. In response to these findings, educators are encouraged to reevaluate their instructional techniques, moving away from conventional models towards more interactive and engaging methods that promote a collaborative exchange of ideas between teachers and students.

Moreover, the research highlights the substantial impact of enhancing the proportion of student group presentations on the overall learning performance of non-accounting major students. Collaborative learning experiences, facilitated through group-based activities and presentations, emerge as valuable contributors to students' academic success. This insight prompts a call for educators to integrate more collaborative elements into their teaching practices, fostering an environment that not only encourages individual comprehension but also nurtures teamwork and shared knowledge acquisition. In doing so, educators can create a more inclusive and participatory learning atmosphere that aligns with the evolving needs and preferences of non-accounting major students in contemporary educational settings.

### **6.2. Reconsidering Assessment Methods**

The study sheds light on a critical aspect of the educational landscape, highlighting that submitting term reports is perceived as the least effective method in stimulating interest among non-accounting major students. This revelation underscores the importance of reassessing and restructuring traditional assessment methodologies within the academic setting. Traditional approaches, such as term reports, may no longer be the most effective means of gauging student understanding and fostering engagement. Consequently, there arises a pressing need for educators to reconsider and evolve their assessment strategies to align with the preferences and engagement levels of non-accounting major students.

In response to these findings, educators are encouraged to explore alternative and innovative assessment approaches that go beyond conventional methods.

Project-based assessments, real-world case studies, and other interactive evaluation methods emerge as potential avenues for consideration.

By diversifying assessment tools, educators can create a more inclusive and engaging evaluation process that resonates with the diverse learning styles and interests prevalent among non-accounting major students. This paradigm shift in assessment methodology not only enhances student engagement but also promotes a more comprehensive and authentic evaluation of their skills and knowledge, aligning with the evolving educational landscape and the needs of contemporary learners.

### **6.3. Addressing Career Confidence**

The acknowledgment of the positive reception of the new teaching formative assessment solution is a noteworthy aspect of the study. However, the identification of a lower percentage of confidence in future career prospects among non-accounting major students signifies a crucial area for potential improvement. That is to say, students believe that even if they learn financial management subjects well, it will not be of much help to their future career paths. This revelation prompts a call for institutions and educators to delve deeper into understanding the factors influencing students' perceptions of their professional future. A comprehensive strategy is essential, addressing not only academic content but also the integration of practical elements into the curriculum that establishes clear connections between classroom learning and real-world applications.

To bridge the confidence gap, educators should consider designing curriculum components that expose students to practical scenarios, industry applications, and real-world problem-solving. This experiential learning can instil a sense of confidence in students regarding their readiness for the professional realm. Moreover, the role of career counselling and guidance programs emerges as critical in supporting students in navigating their career pathways. By providing personalized advice, industry insights, and skill development opportunities, these programs can empower students to make informed career decisions and enhance their confidence in pursuing future professional endeavours. The study highlights the importance of a holistic education approach that not only imparts knowledge but also actively supports students in envisioning and preparing for their careers beyond the classroom.

## 7. Conclusion

The research findings underscore critical insights that warrant a paradigm shift in educational approaches for non-accounting major students.

The emphasis on interactive teaching as the optimal solution highlights the need for dynamic and participatory pedagogical strategies, challenging traditional models in favour of more engaging methods. This signifies a transformative opportunity for educators to reimagine their instructional techniques, fostering a collaborative learning environment that caters to the evolving needs of contemporary learners.

Additionally, the call for reconsideration of assessment methods suggests a move away from traditional approaches, such as term reports, towards more innovative and diversified evaluation tools. Project-based assessments, real-world case studies, and interactive methods emerge as promising alternatives, ensuring a comprehensive and engaging evaluation process aligned with the diverse learning styles and interests of non-accounting major students.

Furthermore, the study underscores the importance of addressing career confidence among students. While the positive reception of the new teaching formative assessment solution is acknowledged, the lower confidence in future career prospects indicates a vital area for improvement. The proposed strategies, including integrating practical elements into the curriculum and enhancing career counselling programs, offer a holistic approach to education. This not only focuses on academic content but actively supports students in envisioning and preparing for their future careers.

In essence, these implications collectively advocate for a more student-centred, engaging, and holistic educational approach that goes beyond traditional boundaries. As educational institutions and educators embrace these insights, they pave the way for a more enriching and impactful learning experience for non-accounting major students, preparing them for success in both academic and professional realms.

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