



Research Article

A multi-engaging and active learning educational transdisciplinary framework, A graduate school implementation

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Abstract

Engineering and management schools face significant challenges in educating the latest generations of students due to their attention span and the hyper-connected networks they have access to. Traditionally, professors have used active tools (such as problem-based learning, project-oriented learning, and the case method) to reach educational goals. In recent years, supportive, engaging tools (gaming and storytelling, among others) have been essential to attract the attention of millennial and centennial students within specific educational activities. Literature shows instances of the positive impact (on student comprehension and skills development) of using a specific active or engaging tool in an educational activity. However, there is a gap in exploring multi-engaging and active learning tools. This research explores using a mixture of active and engaging tools to design single significant motivational, student-centered educational activities to obtain a student's more profound understanding of the management or engineering tool, the skills required to use it, and the potential consequences to stakeholders. The contribution of this work is twofold: a) a transdisciplinary framework to design specific, active, multi-engaging educational experiences that can be deployed among course sections, and b) an illustrative instance based on an operations management graduate course.

Keywords: active educational tools, engaging educational tools, transdisciplinary approach to education.

1. Introduction

A paradigm shift in education, which involves engaging new generation students in graduate programs, is confronted with the imperative to enhance the effectiveness of classroom learning by aligning it with the evolving demands of the digital age. This challenge is underscored by the need for graduates to acquire knowledge and develop practical skills relevant to the contemporary professional landscape (Safapour et al., 2019).

In the words of Panis et al. (2020), the traditional pedagogical practices of rote memorization and unidirectional knowledge dissemination have become archaic relics. It is evident that conventional classroom methods, entrenched in didactic instruction, have lost their efficacy in captivating and motivating the current generation of students (Safapour et al., 2019).

Emerging cohorts of students strongly advocate for a more dynamic and interactive classroom experience that transcends mere knowledge transfer, aiming to capture their attention and stimulate their intrinsic motivation to engage actively. As Lan (2012) defines, motivation encompasses conscious choice and effort toward a specific objective. The principal challenge lies in igniting this motivation within the academic milieu.

Professors instructing courses with high quantitative content often grapple with various student-related challenges, such as dwindling motivation, difficulties grasping complex concepts, a reluctance to ask questions, and limited involvement in problem-solving (Panis et al., 2020). To address these challenges, educators frequently turn to active learning strategies (Pérez-González & Ramírez-Montoya, 2019), a time-tested approach that has gained renewed attention in recent years due to its enriching impact on the learning experience. Research has affirmed that these unconventional teaching methods stimulate student engagement and foster the development of creative and critical thinking skills (Safapour et al., 2019). To enhance the classroom experience, educators must incorporate activities that deter passivity and activate student participation in the learning process (Pérez Gonzalez and Ramírez-Montoya, 2019). Faculty members who take time to understand students' interests and needs develop a better understanding to create interactive teaching activities to strengthen student learning efficiency (Dogani, 2023). Despite the latter, there are still a number of faculty members who believe that active

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learning is a fashion (Alruthia et al., 2019). There are retractions to using active learning teaching tools; thus, sufficient implementation has not been achieved (Murillo-Zamorano et al., 2021).

Under the framework of this student-centric approach, instructors closely monitor the various phases of the teaching and learning process (Cherney, 2011). They must be attuned to the learning cycles, and one noteworthy model aimed at amplifying active learning is the ENGAGE Model (Halsey, 2011), which comprises six key stages: "Energize Learners, Navigate Content, Generate Meaning, Apply Learning, Gauge and Celebrate Learning, and Extend Learning to Action." Despite these well-defined moments for implementing diverse, active learning techniques, instructors typically do not employ these stages sequentially in course design, and a combination of teaching methods remains atypical (Aldalur & Perez, 2023). Given the absence of a one-size-fits-all approach for developing skills across diverse learner profiles (Safapour et al., 2019), it becomes increasingly essential to consider designs that facilitate integrating or fusing multiple active learning strategies for more effective learning.

This paper explores non-traditional active learning strategies and tools (Safapour et al., 2019) that have emerged as pivotal components of educational innovation (Radar of Educational Innovation, 2017). Traditionally, instructors tend to select a single active learning method for their courses (Safapour et al., 2019). Common choices include the flipped classroom (suitable for both undergraduate and graduate levels), the case-based method (widely adopted in management and business schools; Safapour et al., 2019), Problem-Based Learning, Collaborative Learning, and Experiential Learning. Emerging techniques encompass gamification, social media integration, just-in-time learning, storytelling, and self-directed learning. However, there is scant literature about the impact of multi-engaging and active learning tools implemented simultaneously in the same activity.

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This research explores using a mixture of active and engaging tools to design single significant motivational, student-centered educational activities to obtain a student's more profound understanding of the management or engineering tool, the skills required to use it, and the potential consequences to stakeholders.

The contribution of this article unfolds in two dimensions:

1. Formulating a transdisciplinary framework to guide instructors in:
 - a. Assessing the learning cycles.
 - b. Identifying strategies to address challenges and opportunities encountered in teaching academic content.
 - c. Crafting a comprehensive active learning experience seamlessly integrating engaging educational tools.
2. Offering a practical demonstration of the framework's implementation.

In addition to this contribution, which assists educators in systematically implementing innovative active learning strategies, it is imperative to incorporate elements within the framework that facilitate the scalability of the academic experience. This initiative seeks to make the academic experience sustainable and adaptable to various contexts, enabling other instructors to leverage the results obtained during its initial implementation.

In this context, scalability (Niederhauser et al., 2018) refers to disseminating a change, specifically a novel academic experience, in a manner that allows it to be adapted and applied by one or multiple educators in their respective classrooms.

The rest of the paper outlines the transdisciplinary framework for designing, implementing, and scaling (for additional educators) an academic experience that uses a mixture of active and engaging tools. The explanation of the framework is enriched with a practical example. Finally, the conclusion section offers insights and recommendations for future research.

A Transdisciplinary Framework for enriching active learning experiences by integrating a set of engaging educational tools

Table 1 presents the primary contribution of this paper, detailing the transdisciplinary framework designed to strengthen the student-centered classroom experience. The framework's central aim is to amalgamate a diverse set of engaging educational tools in a transdisciplinary manner to achieve course objectives effectively.

The formulation of each unique learning experience hinges on the selection and combination of Multi-Engaging Educational Tools. Notably, Table 2 incorporates an adaptation of the ENGAGE model (Cherney, 2011) into a distinctive framework termed ARAICE (Active knowledge, Recognize meaning, Apply, Integrate meaning, Celebrate and motivate, and Evaluate). ARAICE encompasses the six pivotal learning cycles that an instructor navigates during a class session, as delineated in the six columns of Table 2. The rows in Table 2 align Engaging Educational Tools with the ARAICE Learning Cycles. The first column of Table 2 furnishes a list of non-traditional active learning strategies, and the 'x' marks in Table 2 signify the association between tools and learning moments. This symbiotic relationship is crucial for the crafting of multi-engaging learning experiences.

Table 1. Transdisciplinary Framework for Enriching Active Learning Experiences.

| |
|--|
| Phase 1: Topic selection. |
| 1. Select the academic topic within the related course. |
| 2. Identify the current topic's academic objectives. |
| 3. Identify areas of opportunity or problematic situations weakening the teaching-learning process. |
| Phase 2: Team building. |
| 4. Identify the key stakeholders. |
| 5. Assembly of a Transdisciplinarity Team (TT) representing these stakeholders. Take special consideration to obtain a representative group considering elements such as age, diversity, and digital competencies, among others. |
| Phase 3: Experience redesign. |
| 6. Assess and analyze the existing learning cycle techniques or activities employed for teaching the academic topic. |
| 7. Identify the learning cycle(s) that reveal areas of opportunity or problematic situations. |
| 8. Select and evaluate the pertinent learning cycles in alignment with the learning objectives. |
| 9. Assess and select engaging educational tools (Refer to Table 2). |
| 10. Craft the active learning experience by seamlessly integrating various engaging educational tools. Take special consideration of professor and student profiles (digital knowledge, age differences, among others). |
| 11. Develop a prototype of the activity. |
| Phase 4: Testing |
| 12. Evaluate the prototype with a select group of stakeholders. |
| 13. Collect feedback, pinpoint areas of opportunity, and enhance the experience accordingly. |
| 14. Implement the activity in the classroom with students. |
| 15. Evaluate the results in collaboration with the group of stakeholders. |
| 16. Return to Step 3 if necessary. |
| Phase 5. Scalability analysis |
| 17. Document the current version of the experience for additional potential professor users. |
| 18. Identify potential professor users. |
| 19. Convene a meeting with potential professor users to present the experience (utilizing videos, presentations, documentation, etc.). |
| 20. Assemble a deployment professor team. |
| Phase 6. Experience deployment |
| 21. Select the experience deployment team, consisting of the professor team and the original TT or equivalent representatives. |
| 22. Determine the necessary adjustments required to scale the experience. |
| 23. Modify the experience materials based on the previous step. |
| 24. Return to Phase 4 as often as necessary to refine the final product. |

Table 2. Engaging Educational Tools Framework.

| Engaging Educational Tools | Active knowledge | ARAICE Learning Cycles | | | | Evaluate |
|----------------------------|------------------|------------------------|-------|-------------------|------------------------|----------|
| | | Recognize meaning | Apply | Integrate meaning | Motivate and celebrate | |
| Flipped Learning | | | X | X | | |
| Case Study | | X | X | X | | X |
| Problem-Based Learning | | X | X | X | | X |
| Storytelling | X | | | | X | |
| Gamification | X | | | | X | |
| Collaborative learning | | X | X | X | | |
| Experiential Learning | | X | X | X | | |
| Just-in-time learning | | X | | X | | X |
| Social media | X | | | | X | |
| Self-learning | | X | | | | |

2. Implementing the framework in practice

A transdisciplinary team (TT) comprised of members from EGADE Business School at Tecnológico de Monterrey applied the framework to enhance an academic experience within a graduate-level MBA course context.

2.1. Phase 1: Topic selection

Step 1: Academic topic selection

The chosen course for this endeavor was "Global Operations Management," specifically focusing on "Inventory Management." The topic delved into the intricacies of managing inventory with a single-period model and two opportunities to place orders.

Step 2: Identifying academic objectives

The primary academic objective was to equip students with the capability to differentiate this model from the single-period, single-opportunity-to-order model. Furthermore, students were expected to grasp the underlying mathematical model and its associated solution.

Step 3: Identifying areas of opportunity

The students in this program typically arrived at class with motivation but physically fatigued. This was particularly pertinent as most of these students were part-time, juggling full-time employment and academic pursuits. Consequently, the incorporation of engaging tools became a necessity.

2.2. Phase 2: Team building

Step 4: Identifying key stakeholders

The stakeholders involved in this initiative included the Operations Management faculty of the MBA program at EGADE Business School, members of the Educational Innovation area, and the Pedagogical Architecture and Digital Learning area at Tecnológico de Monterrey, in addition to the MBA students themselves.

Step 5: Assembling the TT

The TT was assembled, encompassing a diverse array of expertise. The team consisted of an Operations Management professor, an instructional designer, a video producer, a production manager, an innovation coordinator, and an expert consultant in gamification.

2.3. Phase 3: Experience redesign

Step 6: Assessing the existing learning cycles and techniques

The existing teaching method for this topic employed the case method, particularly focusing on the "Sports Obermeyer" case (Hammond & Raman, 1994). The professor identified three key phases:

1. Pre-Session:
 - a. Individual students were required to read the case from an analytical perspective.
 - b. Submit a document comprising a case summary, a solution strategy, and a progress report on the implementation of the solution strategy.
2. During Session:
 - a. The group engaged in a discussion facilitated by the professor, focusing on the case's critical elements and converging on defining the problem or opportunity area.
 - b. The professor provided insights on various quantitative tools relevant to solving the problem as identified in the previous phase.
3. Post-Session:

Each student was expected to submit a one-page reflection document with the main takeaways from this activity.

Step 7: Identifying learning cycles

The TT recognized that during the session, the discussion phase was one of the process's most challenging and time-consuming moments (2.a). It was noted that most students had completed a full day of work, and the evening class hours left them physically fatigued. To overcome this hurdle, the TT introduced an active learning strategy.

Step 8: Selecting and evaluating learning cycles

Two learning cycles from Table 2 were targeted for enhancement: "Recognizing meaning" (column 3) and "Motivate and celebrate" (column 6). The objective was to infuse engagement into the case discussion process, making it a more dynamic and interactive experience.

Step 9: Assess and select engaging educational tools

A comprehensive review of Table 2 led to the inclusion of storytelling, gamification, and collaborative learning as supplementary tools integrated with the case method.

Step 10: Craft the active learning experience

The TT engaged in three meetings to craft the content for the active learning experience. This involved the creation of a Mars-set storytelling video (to introduce the case from a unique perspective) and the development of a board game (gamification). The game comprised a board and cards filled with information pertinent to case analysis. This novel activity, designed for small teams of students, replaced the previous in-class group discussion, which the professor previously coordinated. The game's objective was to foster convergence among student teams regarding the core elements of the case and the principal decision to be taken by the company's executive team. Additionally, the design encompassed elements like game rules, activity duration, and team roles and commitments. Moreover, students who completed the game were encouraged to join other teams still playing, promoting collaboration and teamwork.

Step 11: Developing a prototype

Figures 1 through 3 visually depict the resources envisioned for this transdisciplinary academic experience.



Figure 1. Board Game Design.

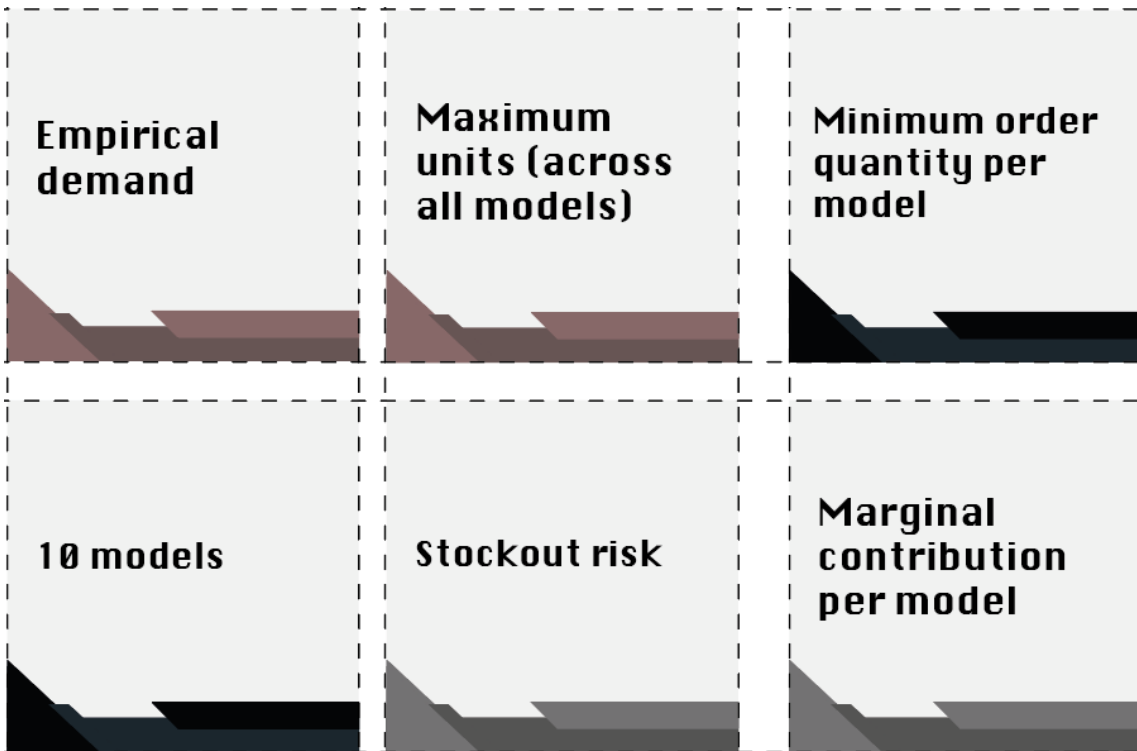


Figure 2. Example of Cards.

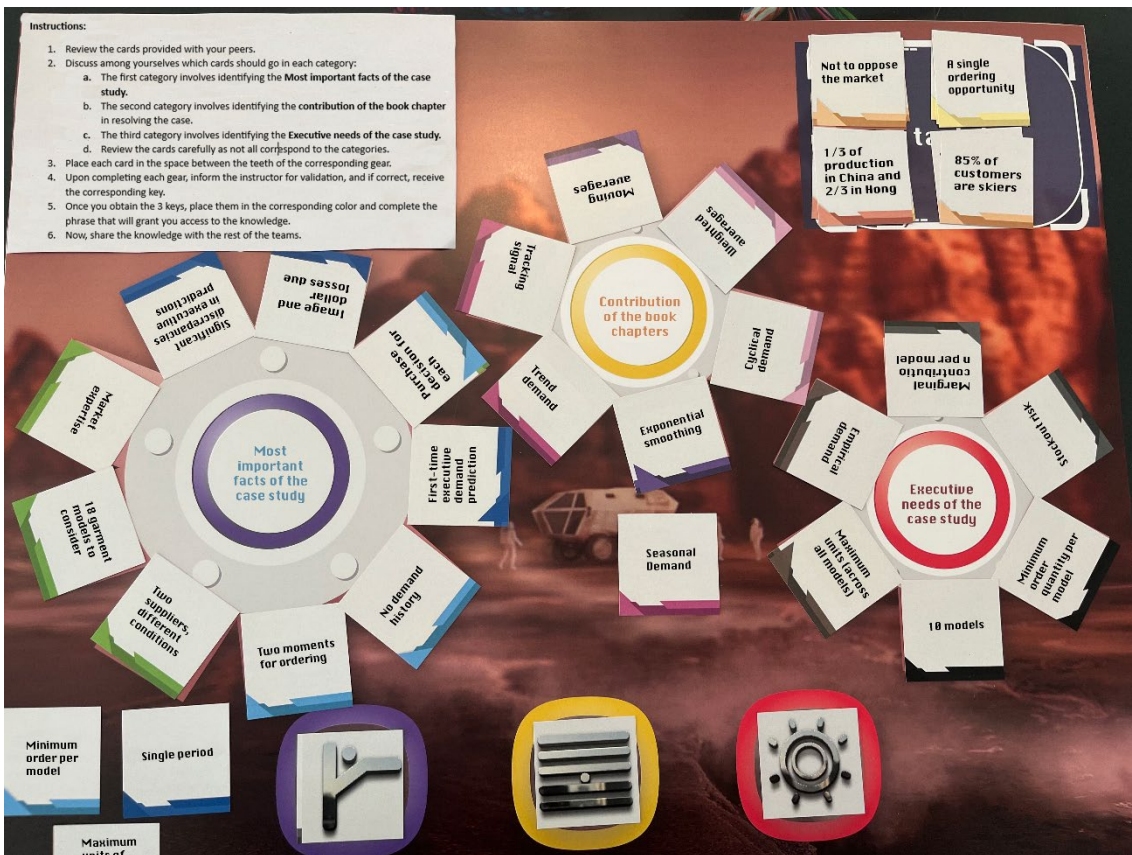


Figure 3. Example of Board Game at the end of the experience.

2.4. Phase 4: Testing

Step 12: Evaluating the prototype with stakeholders

At this key step in the design process, a select group of TT members convened in an informal setting to scrutinize the complete experience. Their objective was to question various aspects, verify the phases, clarify instructions, and assess the extent to which the objectives had been met.

Step 13: Collecting feedback

During this assessment, the TT identified areas of opportunity in the activity's logistics and engagement elements. Consequently, the team devised a poka-yoke card (Jacobs & Chase, 2013) to simplify the professor's evaluation of the student's status within the game. Additionally, the team introduced a high-sound bell to be used by the professor, serving as a signal to the entire class when a student team reached a significant milestone in the game.

Step 14: Implementing activities in the classroom

During the summer term of 2022, the MBA program at EGADE Business School in Monterrey conducted the Global Operations Management course with two separate sections—one on Thursday and the other on Friday evenings, each comprising 30 students. The TT implemented the activity in both sections during the inventory management session.

From the professor's view, the students were significantly more active and enthusiastic during the redesigned activity than in previous groups (who did the same in the classic group discussion format). In addition, as a side effect of the implementation, the students in both sections (Thursday and Friday) experimented a higher level of positive energy for the remainder of the session, where other topics were exposed.

Step 15: Evaluating the results with stakeholders

The student's experience evaluation was facilitated through an anonymous electronic survey. The response rates and dates of the activity's implementation are summarized in Table 3. Interestingly, it is worth noticing that Group 1 (Thursday evening) and Group 2 (Friday evening) yielded varying response rates. The difference could be attributed to the day and time of the activity, although further investigation is needed to confirm this hypothesis.

Table 3. Group and survey response information.

| Group 1 | Group 2 |
|---|---|
| Date: Thursday, August 25, 2022 Session 18:30-21:30 | Date: Friday, August 26, 2022 Session 18:30-21:30 |
| Number of students: 30 | Number of students: 30 |
| Number of survey responses: 21 | Number of survey responses: 12 |

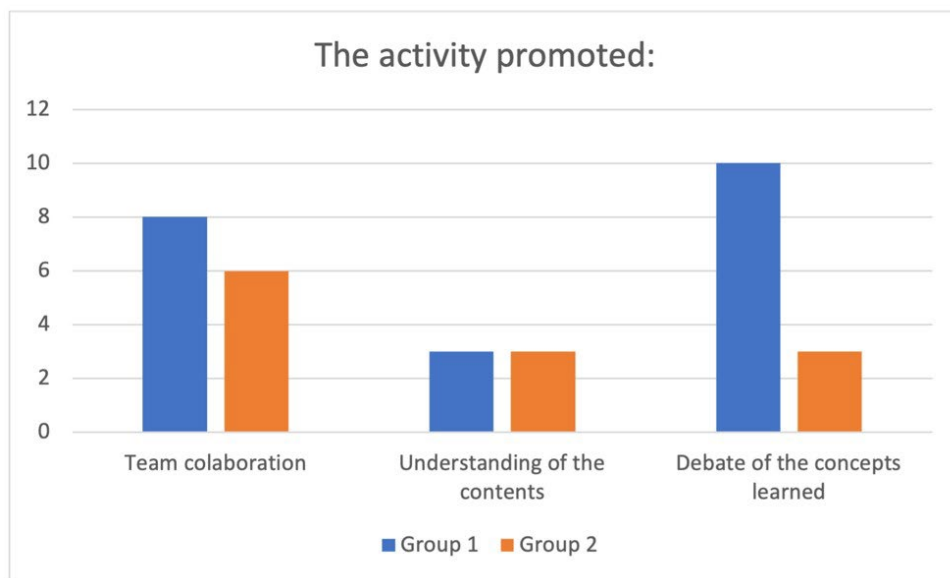


Figure 4. Contribution of the activity (by number of students expressing the primary outcome of the activity).

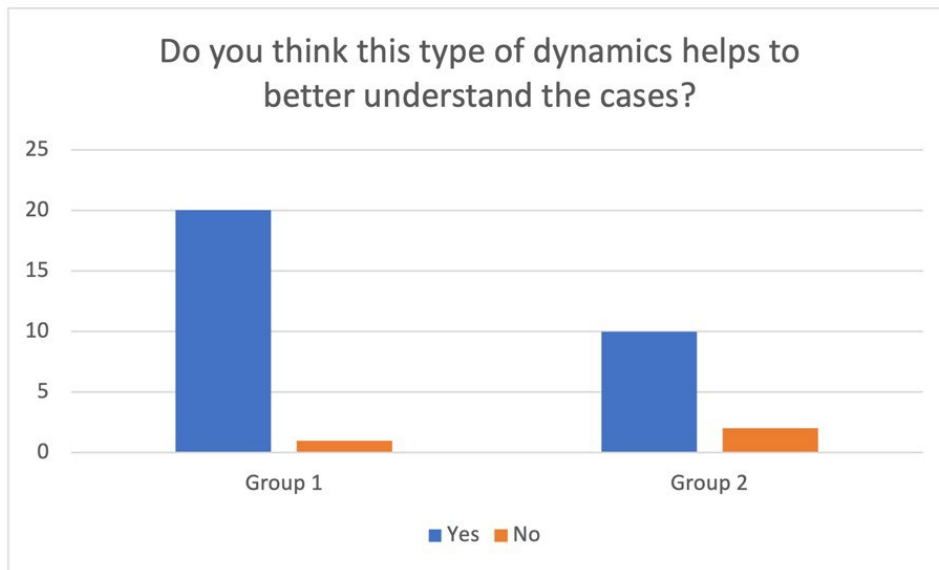


Figure 5. Understanding of the case.

The survey encompassed two key multiple-choice questions and an open-ended query:

- a) Students were asked to choose the primary contribution of the activity from three options, as depicted in Figure 4. The first group emphasized the debate of learned concepts, whereas the second group emphasized team collaboration. Despite identical teaching processes, the reasons for this discrepancy in appreciation are yet unclear, potentially due to the differing days of the week—a facet requiring further research.
- b) In response to whether this activity aided in a better understanding of the academic case under study compared to their previous experiences with the classic case method (Figure 5), the majority from both groups responded affirmatively.

Furthermore, students offered comments regarding the experience in an open format and suggested improvements, such as making the game cards adhesive (to the game board) for better functionality. The TT considered and implemented specific recommendations for the second group, demonstrating their responsiveness to student input.

It is worth mentioning that these results refer to the students surveyed only and should be further explored in future implementations of the activity.

Step 16. If necessary, return to step 3. The TT got together after reviewing the feedback obtained through the survey and direct comments from students. Some areas of opportunity referred to the game instructions and the clarity of the text of some cards.

2.5. Phase 5: Scalability analysis

Step 17: Documenting the experience for additional potential professor users

Following completing the activity and evaluating its implementation, the TT meticulously documented the experience. This documentation included key aspects such as learning objectives, employed strategies, utilized resources, application methods, and the content applied during the activity. It offered a comprehensive insight into the instructional design, final materials, and the impact assessed through student evaluations.

Step 18: Identifying potential professor users

The department leader was enlisted to provide a list of professors teaching this subject in forthcoming academic periods, encompassing face-to-face and virtual formats at other EGADE locations beyond the Monterrey site. This list was pivotal in the planning phase.

Step 19: Convening a meeting with potential professor users

The TT organized a meeting with the prospective professors to present the academic experience and the results it had yielded. During this gathering, the team showcased the storytelling in video format and the board game, providing a tangible understanding of the materials used. During this scalability implementation phase, one of the professors who attended this meeting expressed willingness to incorporate this activity into their face-to-face class.

Step 20: Assembling a deployment professor team

The educational innovation coordinator assigned the production team to the professor who had opted to adapt the activity to their course.

2.6. Phase 6: Experience deployment

Step 21: Selecting the experience deployment team

The educational innovation coordinator convened a kick-off meeting with the team tasked with supporting the professor in adapting the activity for classroom use. This team encompassed the original TT or equivalent representatives.

Step 22: Determining the necessary adjustments to scale the experience

The TT involved in the experience deployment held two critical meetings with the professor. The first session included the original activity designer professor, who explained how the activity was implemented in their class. The second session entailed the adapting professor presenting the changes to the board, including adjusting the number of cards per category and using only cards with correct answers while eliminating the extra cards used in the original activity. Additionally, a translation of the board, cards, and instructions into English was requested, as the activity would be conducted in that language.

Step 23: Modifying the experience materials

The TT made necessary adjustments to the board and card designs and translated the text to produce the required kits for the professor.

Step 24: Returning to phase 4 as necessary

Only steps 14 and 15 were carried out during the testing phase since the original activity had already been tested.

3. Conclusions and future work

Due to the unique characteristics of new student generations, it has become increasingly essential for professors to integrate active learning strategies into their courses over time. In this context, this article makes a twofold contribution. Firstly, it addresses graduate and undergraduate academic education, emphasizing learning strategies and instructional design. It proposes a transdisciplinary framework integrating multi-engaging educational tools into active learning experiences, ultimately enhancing students' critical thinking. Secondly, it provides an implementation instance to showcase the framework in practice, elucidating some of the associated benefits. At implementation, it was found that the redesigned activity generated an equivalent level of knowledge learned by students in previous terms but significantly improved the energy and enthusiasm not only during the activity but for the remainder of the session where other topics were exposed.

This article underscores that using the presented framework can assist professors in objectively evaluating their academic practices and activities. It fosters greater clarity in identifying improvements in the student-centered teaching process through detailed analyses of each learning cycle.

Furthermore, professors are encouraged to integrate more than one strategy in their classes, as the framework offers a variety of methodologies that can be thoughtfully combined, resulting in a transformative experience and more effective activation of learning.

Future research endeavors include a comprehensive exploration of the needs of new student generations, heterogeneity of class elements such as velocities of reasoning and student perceptions, a deeper understanding and implementation of this framework across various courses in the MBA and other graduate programs within the school and university, and the potential for its transfer to other academic institutions. Professors and university staff can harness these elements to expand their repertoire of active learning strategies within the framework, offering them a broader spectrum of options.

The authors emphasize that the experience described in this paper was executed using physical boards and cards. Implementation of the framework in online environments using digital tools in conjunction with physical elements has the potential to enhance outreach and enrich the learning experiences, further advancing the framework's effectiveness.

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