Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/SA6.20250177
Published: May 12, 2025

The Integration of Active Methodology with Gamification in the Teaching of Production Engineering

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Abstract

The adoption of active learning methodologies has proven to be an effective alternative to traditional teaching, especially in subjects with dense and theoretical content. In order to promote a dynamic learning experience and increase student engagement, the World Café active methodology was integrated with the gamification of Kahoot!, within the subject of Manufacturing Methods and Processes, for third-semester students of Production Engineering. In the activity, students were divided into thematic stations. Each station leader received specific content and was responsible for studying and presenting it. The remaining students, called travelers, took turns between the stations to learn from the leaders. At the end of the rotations, they returned to their original station to share the knowledge acquired. The teacher acted as a facilitator, answering questions throughout the process. After the discussions, a Kahoot! quiz was administered to assess content retention and provide immediate feedback. At the end of the experience, students answered a satisfaction survey. The results showed a high approval rate: 91.7% gave the activity a score of 10 and 8.3% gave it a score of 9. Student feedback highlighted increased engagement, improved understanding of the content, and the development of interpersonal skills such as communication, active listening, and teamwork. These results suggest that combining active methodologies with gamification is an effective and replicable teaching strategy in higher education, especially in engineering programs with highly technical content.

Keywords
Active Learning, Gamification, Engineering Education, Manufacturing Processes and Production Engineering.

1. Introduction
With each passing year, the challenge in higher education of promoting more meaningful learning experiences grows. Traditional approaches based on fully expository classes create great difficulty in engaging students, especially in technical content such as that covered in the Production Engineering course. Active learning methodologies and the incorporation of gamification have been adopted more frequently to face this challenge, encouraging participation, autonomy and critical thinking among students.

Among the existing active methodologies, there is the “World Café” methodology, which stands out for providing in-depth dialogue on the work topic, in addition to enabling an increase in the development of interpersonal skills, such

as communication, active listening and teamwork. At the same time, gamification tools such as Kahoot! capture students' attention, improving their motivation and participation in classes, evolving the review of content into an interactive experience and enabling instant feedback.

This article presents a teaching experience combining the World Café active methodology with gamification through the Kahoot! website in the Manufacturing Methods and Processes discipline for third-semester production engineering students, in a topic called "Manufacturing Processes".

In the end, the results of this research aim to contribute to the body of knowledge on active methodologies in teaching production engineering and provide practical insights for educators and teachers seeking innovative approaches to improve students' learning experiences, especially in classes with highly theoretical content.

1.1 Objectives

The objective is to evaluate how the integration of these two active approaches influences student engagement, knowledge retention and the development of interpersonal skills in an undergraduate production engineering course, in addition to understanding students' perceptions of the use of these approaches.

2. Literature Review

Universities need to focus on improving their teaching and learning methods to provide better preparation for their students, improving the methodologies used in the classroom, where the traditional model focused only on lectures should be replaced by practical experiences for their students (Paccola et al. 2014). Souza et al. (2019) state that higher education institutions should include the use of active methodologies to increase student engagement.

Bussolotti et al. (2018) state that meaningful learning occurs through measurement between teachers and students, and students and their peers, with the student being the central element of the teaching-learning process, therefore, the use of active methodologies is important.

Silva et al. (2024) explain that it is still common to come across the idea of a classroom where students are the receivers and the teacher has a central role as a transmitter of knowledge. However, with developments, this process has been changing and other methodologies have emerged, where the focus is on the student as the protagonist of their own learning.

Lima et al. (2022) state that the use of active methodologies has been providing the construction of knowledge, in a way that considers students' motivation and experiences, making the teaching-learning process more harmonious.

Kampff and Silva (2020) describe gamification as a trend in the development of skills for students. In addition, Marques (2018) states that gamification is the use of game elements applied in a non-game context. Silva et al. (2024) state that gamification is capable of generating engagement among higher education students.

There are several options for gamification tools to be applied in the teaching-learning process. Among the options available on the market, one of the most widely used is Kahoot!, a game-based teaching tool launched in 2013 that allows users to create quizzes to test students' knowledge in an engaging way (Marques 2018).

Also according to Marques (2018), the teacher can create multiple-choice questions for students, allowing for competition between students when answering the questions. The author explains that the goal of Kahoot! is to get students to answer the questions created by the teacher as quickly and correctly as possible. At the end of each question, the answer is presented, allowing for a real-time feedback process, and at the end of the game, the best-performing students are highlighted (Marques 2018).

Lima et al. (2022) describe the World Café methodology as an active methodology based on peer education, and describe that the process occurs with students at the same educational level working in pairs with the aim of developing new knowledge, through the use of a simple conversion method, promoting an enriching dialogue and accessing the collective intelligence of the group.

Bussolotti et al. (2018) describe that the World Café methodology contributes to the construction of knowledge from the perspective of active learning. Lima et al. (2022) states that the World Café active methodology is a collaborative, creative and easy-to-understand teaching-learning methodology, which allows for dialogues to be generated between people who have similar purposes, which allows the traditional teaching path to be broken, building new ways to reproduce knowledge.
Brown and Isaacs (2007) state that there are 7 principles that should be taken into consideration when using the World Café technique, which are: 1) Establish the context; 2) Create a welcoming space; 3) Explore significant issues; 4) Encourage everyone to contribute; 5) Connect different points of view; 6) Listen together to establish patterns, insights, and deeper questions; 7) Gather and share significant findings.

According to The World Café Community Foundation (2025), the active "World Café" methodology is based on a simple, effective, and flexible format for conducting dialogues in large groups, where each element of the method has a specific purpose. In addition, it is possible to make modifications to the World Café in order to meet specific characteristics. Also according to The World Café Community Foundation, there are five components that make up the basic model for applying the World Café, which are: 1) Scenario; 2) Welcome and introduction; 3) Small group rounds; 4) Questions and 5) Harvest.

3. Methods

The method used in this study is characterized as applied research, conducted through a didactic-pedagogical experience developed in higher education. The application was carried out in a class of the Manufacturing Methods and Processes discipline, taught in the third semester of the Production Engineering course at FACENS.

The methodological proposal involves the integration between the active World Café methodology and gamification through Kahoot!, with the objective of increasing student engagement, promoting understanding of the content and stimulating the development of socio-emotional skills.

The class was structured in 5 stages, organized as follows:

Stage 1 - Class division and preparation of stations: The class was divided into five groups, and each group was positioned at a station (table). Each station represented a specific topic of the class on manufacturing processes.

Stage 2 - Distribution of roles: One student from each station was appointed as leader (called a host), responsible for studying the content beforehand and presenting the main ideas, generating discussion on the topic. The remaining students were organized as "knowledge travelers" and took turns going through the stations.

Stage 3 - Discussion rounds: In each round, the travelers moved to a new station, where the leader explained the content. The students could ask questions and briefly discuss the topic presented. At the end of the allotted time, they moved again to the next station.

Stage 4 - Return to the original station: After all the travelers had passed through the stations, they returned to their original station to share with the leader the knowledge acquired at the other tables, promoting collective learning. The time for this last discussion was 10 minutes.

Stage 5 - Kahoot! Application: At the end of the World Café application, the students answered a gamified quiz with questions related to the proposed topics, as a way to review and consolidate the knowledge built throughout the stations.

The teacher acted as a facilitator throughout the process, clarifying doubts, guiding the discussion and observing the engagement of the groups.

4. Data Collection

Data collection was carried out through a class evaluation questionnaire and also through direct observation of student participation during the class.

The questionnaire aimed to assess the level of student satisfaction with the methodology applied, in addition to identifying the main lessons learned. The questions in the questionnaire were:

1) In a few words, summarize what was your main lesson learned from today's class;
2) How much did you like the class? (scale of 1 to 10);

3) How much do you recommend this type of class? (scale of 1 to 10).

The two scale questions allowed for direct measurement of the degree of acceptance of the methodological proposal, while the open question provided qualitative support for analyzing the content assimilated by the students.

The responses were tabulated and analyzed. In addition to the questionnaire, the teacher made direct observations throughout the dynamic. Direct observation was conducted by the teacher in charge, with notes taken throughout the class, considering: student participation in discussions, peer collaboration, interest shown in the stations and involvement during the application of Kahoot!.

This combination of quantitative and qualitative data allowed a broader understanding of the effects of integrating the active world café methodology with the gamification of Kahoot! on student learning and experience.

5. Results and Discussion

5.1 Numerical Results

The quantitative results of the questionnaire applied at the end of the class showed a strong acceptance by the students regarding the integration of the World Café methodology with Kahoo! Gamification. Of the 20 students present in class that day, 12 participated in the evaluation survey, totaling a response rate of 60%. Table 1 presents the individual responses to the questions, in addition to the reports on the main learning obtained in the activity.

Table 1. Results of the activity evaluation questionnaire

Student	In A Few Words, Summarize What Was Your Main Learning from Today's Class?	How Much Did You Enjoy the Class?	How Much Do You Recommend This Type of Class?
Student 1	Great.	10	10
Student 2	Processes.	10	10
Student 3	Manufacturing methods and their applications.	10	10
Student 4	Various manufacturing and production processes.	10	10
Student 5	How to develop quick thinking skills to understand different subjects and be able to answer questions as quickly as possible.	10	10
Student 6	How manufacturing works, what manufacturing processes are like, how it changes the economy.	10	10
Student 7	The difference between production and manufacturing.	10	10
Student 8	Manufacturing methods.	10	10
Student 9	Learning about manufacturing methods and processes, covering in-depth topics on value addition.	10	10
Student 10	Manufacturing Processes.	10	10
Student 11	Topics related to the manufacturing process.	9	9
Student 12	Manufacturing processes and their implications.	10	10

The average score given to both the question "How much did you like the class?" and the question "How much do you recommend this type of class?" was 9.91. It can be seen that 100% of the students participating in the survey gave scores of 9 or 10 to both questions, with 91.7% giving the maximum score (10). This shows a very high level of approval of the strategy applied by integrating World Café with Kahoot!.

Furthermore, when analyzing the responses to the question "IN A FEW WORDS, SUMMARIZE WHAT WAS YOUR MAIN LEARNING FROM TODAY'S CLASS?" it is possible to observe that the reports demonstrate understanding of the technical content covered and, in some cases, indicate the development of cognitive skills, such as agility in reasoning, described by student 5.

5.2 Graphical Results

The graphs presented in Figures 1 and 2 show, individually, the grades given by students to the questions: "How much did you like the class?" and "How much do you recommend this type of class?", respectively. It is worth noting that both used a scale of 1 to 10.

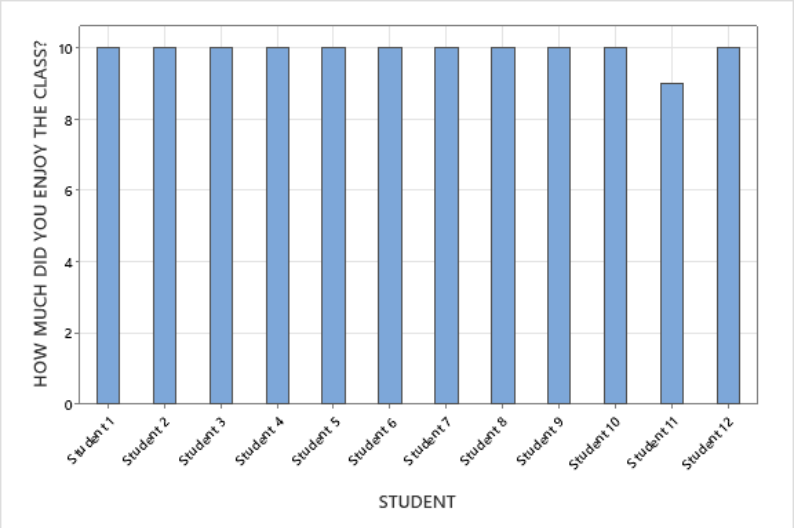

Figure 1. Scores assigned to the question "How much did you enjoy the class?"

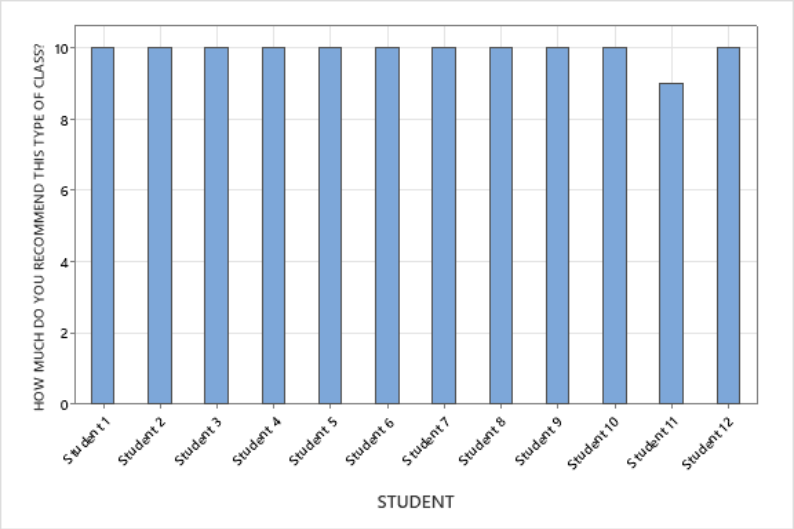

Figure 2. Scores assigned to the question "How much do you recommend this type of class?"

The two figures confirm the predominance of maximum evaluations (grade 10), with only one student giving a grade of 9 to each question. It is noted that the student who gave a grade of 9 to one question also kept a grade of 9 to the other, which suggests consistency between the level of satisfaction and the recommendation of the methodology used in the class.

The uniformity of the data shows a positive perception of the class in relation to the methodology applied. Furthermore, the comparison between the two figures indicates consistency between the level of satisfaction and the level of recommendation of the strategy, suggesting that the experience was well evaluated in both the emotional and pedagogical aspects. The small variation in the grades (with only one student giving a grade of 9) indicates homogeneity in the positive perception of the class among the respondents.

5.3 Proposed Improvements

Even though the results demonstrated a high level of satisfaction perceived by students, it is possible to consider future improvements for the application of the World Café methodology integrated with Kahoot!.

One of the main challenges observed by the teacher was time management, since the dynamics involved multiple stations and required rotation between groups, which could limit discussion within the stations. Therefore, it is recommended to reduce the number of stations, allowing greater use of interactions in each round. In addition, more visual and objective support materials could be provided to the station leaders, with ready-made questions to help organize the explanation of the content, favoring clarity in communication.

Regarding gamification, the use of Kahoot! was well evaluated, however, one proposed improvement would be the inclusion of a debriefing moment after the quiz to reinforce the consolidation of the content. In addition, Kahoot could be applied in two moments, one before the World Café and the other after, to measure the knowledge gained in a more objective way.

5.4 Validation

The validation of the proposal presented in this article was carried out based on two dimensions: 1) the students' perception and 2) the teacher's observation.

The data collected through the questionnaire showed high approval and engagement rates among students, with 100% of the students who responded to the survey giving a score of 9 or 10 for the class format and for recommending this type of class.

In addition, an observation made by the teacher during the integration of World Café with Kahoot showed behaviors compatible with active learning: voluntary participation in the sessions, involvement in the applications and motivation during the gamified quiz. These elements corroborate that the integration of the World Café methodology with Kahoot promoted an environment conducive to the collaborative construction of knowledge.

To increase the robustness of the validation in future applications, it is suggested that pre- and post-tests be used to measure the real impact of the integration of the World Café methodology with Kahoot on student learning, strengthening the results obtained.

6. Conclusion

This article presented the results of the integration of the World Café active methodology with gamification through Kahoot! in the context of the Manufacturing Methods and Processes discipline in the Production Engineering course. The proposal sought to innovate in the way of approaching traditionally dense and theoretical content, promoting a more engaging, collaborative and meaningful learning experience, meeting the objectives proposed by active methodologies.

The results found revealed that the combination of the World Café methodologies with Kahoot! achieved the proposed objectives: there was an increase in student engagement, improvement in content retention and development of soft skills, such as communication, active listening and teamwork. The high satisfaction rate (with 91.7% of students giving

the class the highest grade) and the coherence of the qualitative responses reinforce the effectiveness of the proposed class.

The study offers a replicable and adaptable proposal to different disciplines and teaching contexts, especially in production engineering courses, where there is a great challenge of integrating theory and practice, maintaining student engagement. The use of active methodologies combined with digital tools has shown promise in capturing students' attention and engagement, developing the classroom into a more interactive environment where the student is the protagonist of the learning process. Thus, the contributions of this study stand out in two main dimensions: 1) Practical, by providing an innovative teaching alternative that can be applied to courses with highly technical content; 2) Theoretical, by strengthening the literature on active methodology and the development of soft skills in higher education.

Thus, the objectives outlined in this study were complete, both in analyzing the impact of the methodology on engagement, learning and the development of skills, and in understanding the student's perception of the experience. Future studies propose the application of pre- and post-class assessment instruments to enable more in-depth statistical validation and generate new evidence on the pedagogical impact of the proposed approach.

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