

ENHANCING STUDENT ENGAGEMENT AND INTEREST IN LEARNING THROUGH RANDOM CLASSROOM ACTIVITIES: AN EXAMINATION OF FACTORS INFLUENCING STUDENT SATISFACTION USING RANDOM FOREST ALGORITHM

Anutchai Chutipascharoen¹, Soradech Krootjohn², and Jeeranun Tasuntia^{1,*}

¹Department of Computer Technology, Faculty of Agriculture and Technology,
Rajamangala University of Technology Isan Surin Campus

²Department of Computer Education, Faculty of Technical Education,
King Mongkut's University of Technology North Bangkok

Received: 23 October 2025

Revised: 25 December 2025

Accepted: 26 January 2026

Abstract

After the COVID-19 pandemic, educational institutions shifted from online back to face-to-face learning. However, this transition resulted in decreased student engagement, mainly due to the prolonged period of prior online learning. Researchers sought to increase student engagement by implementing random classroom activities based on student interests. The purpose of this study was 1) to develop a conceptual framework for implementing random classroom activities based on students' interests, 2) to evaluate students' satisfaction with the use of random classroom activities based on their interests, and 3) to identify factors that influence their satisfaction. Methods: The study used a comprehensive approach that included reviewing relevant theories, developing a conceptual framework, conducting experiments, collecting data, and analyzing data using descriptive statistics and the random forest algorithm. The study involved 60 undergraduate students (n = 60) and employed a mixed analytical approach, including descriptive statistics and a Random Forest algorithm, to explore non-linear relationships among learner-related variables. The Random Forest model achieved an overall classification accuracy of 83.33%, providing exploratory insights into factors associated with student satisfaction. Results: Students

* Corresponding author: Jeeranun Tasuntia

E-mail: jeeranunt.ta@gmail.com

reported a high level of satisfaction with the random activities tailored to their interests, with a mean rating of 3.80 and a standard deviation of 1.08. Based on the random forest algorithm, the primary factor influencing student satisfaction was their grade point average (GPA), which had the highest importance value of 0.29. Conclusions: This result highlights the significant role that students' academic performance and learning ability play in determining their level of satisfaction.

Keywords: Student interests, Random classroom activities, Active learning, Machine learning, Random forest

Introduction

After the COVID-19 pandemic, as infection rates declined compared to previous outbreaks, many educational institutions transitioned from online learning back to traditional face-to-face instruction. This transition has had several positive effects on both students and instructors in a variety of fields. For example, the return to traditional educational settings has proven beneficial in fields that require hands-on engagement, such as programming or experimental scientific disciplines. These disciplines require students to engage in hands-on activities to gain experiential learning, and they benefit greatly from the guidance of expert instructors to more effectively achieve their learning goals. A study by Taneja and Dutt (2021) found that 75.32% of students preferred traditional face-to-face learning, believing that instructors were more effective at imparting knowledge in person.

However, the prolonged period of online learning led to changes in students' learning behaviors when they returned to traditional face-to-face classes. In addition, Cickovska (2020) found that instructors faced increasing difficulties in teaching, primarily due to a decrease in student engagement and class participation. Students often engaged in behaviors unrelated to learning, such as looking out the window, talking to classmates, and using smartphones for entertainment. These behaviors led to increased disengagement, which is supported by Taneja and Dutt's (2021) finding that 65.8% of students preferred learning sessions that lasted 30-45 minutes, while 33.5% preferred sessions

that lasted only one hour. In addition, most current college students, often categorized as Gen-Z, are accustomed to immediate and rapid results in the classroom. The observed behavioral trends present significant challenges for instructors in managing classes, preparing learning environments, and effectively allocating class time to meet the needs of today's learners.

Additional research by Cickovska (2020) found that many instructors believed they needed to find ways to motivate students, increase their interest, and engage them more effectively. However, the expected results were not achieved because students did not respond as expected. The observed decline in student engagement during classes longer than 30-60 minutes negatively impacted courses that required longer class periods. In addition, the underlying characteristics of Gen-Z students, who are digital natives (Seemiller & Grace, 2017), contribute significantly to this trend. Given these challenges, addressing student engagement in traditional classrooms following the COVID-19 pandemic has become a critical focus. The purpose of this study is to explore strategies that instructors can implement to increase student engagement and improve learning outcomes.

Research in the field of education has shown that Active Learning has gained significant attention in recent years. This learning model emphasizes engaging students in hands-on activities rather than relying solely on lectures (Johnson & Johnson, 2008). It places students at the center of the learning process and requires their active participation in the classroom (Prince, 2004). Such engagement helps students effectively develop their skills through active involvement in various activities (Michael, 2006). In addition, participation in these activities promotes critical thinking, problem solving, and teamwork. A study by Burrowes (2003) compared exam scores between a control group taught using traditional method and an experimental group using Active Learning techniques. The results showed that the experimental group performed significantly better. There is substantial evidence that Active Learning enhances both knowledge acquisition and skill development. As a result, the benefits of implementing Active Learning in the classroom are numerous, making it a promising solution to the problem of student engagement.

To support such innovative teaching approaches, technology serves as a key enabler. It plays an important role in the development of all sectors, including improving the quality of life (Fullan, 2013). It increases work efficiency, reduces time spent on tasks, minimizes redundancy, and reduces energy consumption. In the education sector, technology is used extensively to improve teaching and learning processes. Information technology is critical for creating innovations, including classroom activities that foster better interaction between teachers and students (Duhaney & Zemel, 2000). According to Drigas and Angelidakis (2017), the integration of technology into education offers measurable benefits for all stakeholders, impacting both direct learning outcomes and broader educational environments. A key benefit of technology is its ability to facilitate learning anytime, anywhere, enabling students to learn more effectively. As a result, technology is essential for the advancement of the education sector. García-Morales et al. (2021) emphasized the importance of understanding the strengths and limitations of existing technologies before improving or developing a new one. This approach ensures that new technologies address existing challenges and lead to more effective solutions. In addition, research by Muthuprasad et al. (2021) showed that appropriately designed educational technologies could significantly improve learning outcomes and overall efficiency.

Based on the studies reviewed, the researcher developed a conceptual framework for implementing random classroom activities tailored to students' interests, supported by educational technology, and integrated within the framework of Active Learning. The goal is to develop classroom activities that actively engage students and increase their interest in learning. This research aims to explore student satisfaction and identify factors that influence satisfaction in higher education, with the intention of providing insights into the design of classroom activities that address student engagement issues and contribute to future educational strategies. Learners in Generation Z exhibit complex, dynamic, and non-linear learning behaviors influenced by multiple interrelated factors, including academic performance, learning preferences, technology familiarity, and engagement patterns. To address this complexity, this study employed a Random Forest algorithm, a machine learning technique well-suited for modeling non-linear relationships and high-order interactions without requiring strict

parametric assumptions. Random Forest enables the identification of relative feature importance across multiple dimensions of learner experience, providing a more nuanced understanding of the factors contributing to student satisfaction in active learning environments.

Objectives

1) To develop a conceptual framework for implementing random classroom activities aligned with students' interests, incorporating educational technology within the context of Active Learning, to increase student engagement in higher education.

2) To examine the satisfaction levels of undergraduate students with the implementation of random classroom activities tailored to their interests, supported by educational technology, and integrated within the framework of Active Learning.

3) To explore the perspectives of undergraduate students regarding the implementation of random classroom activities tailored to their interests, supported by educational technology, and integrated within the framework of Active Learning.

4) To investigate the factors influencing undergraduate students' satisfaction with the implementation of random classroom activities tailored to their interests, supported by educational technology, and integrated within the framework of Active Learning.

Literature Review

Classroom activities are an integral part of the Active Learning model, which emphasizes student participation. This approach plays an important role in teaching and learning by enhancing learning effectiveness and increasing student engagement. Classroom activities positively impact students physically, cognitively, and emotionally, all of which are essential for learning and skill development (Dinkel et al., 2017). Effective classroom activities include several key elements. Miller et al. (1988) emphasized that creating situations in which students feel personally connected to the material significantly increases their engagement. However, Deci (1971) argued that imposing excessive conditions

for participation can decrease student interest. In addition, encouraging future participation through rewards may increase the frequency of repeated engagement. Higgins (2000) further emphasized that fun activities and an appropriate atmosphere can motivate students to participate in activities again.

Factors that influence students' interest in classroom activities include personal interests, past experiences, academic disciplines, and various complex internal factors (Ainley, 2012). Students' initial interest plays a significant role in their participation, as activities that align with their interests encourage engagement without hesitation. Izard (2007) emphasized that interest significantly influences learning behaviors. Therefore, it is essential to develop techniques for classroom activities that effectively capture students' attention. Research by Gentry et al. (2002) found that students' level of education influences their interest and enjoyment of activities. At higher levels of education, students are more likely to engage in activities because such activities are less frequent compared to lower levels where they are more frequently incorporated.

Additional recommendations for conducting classroom activities suggest that they should be simple and not overly complex, allowing instructors to manage the classroom more effectively. Moreover, the duration of the activity should ideally be between 5 and 10 minutes to maximize its appeal (McMullen et al., 2014). Based on the research findings mentioned above, it can be concluded that classroom activities have a positive impact on students, increasing their engagement and improving their learning behaviors. However, instructors must remain mindful of the potential challenges discussed in order to ensure the success and effectiveness of these activities for both students and instructors. Learning psychology research suggests that randomized outcomes can stimulate intrinsic motivation by reducing predictability and increasing novelty, thereby encouraging continued engagement. Consequently, this study aims to develop a conceptual framework for implementing random classroom activities that are aligned with students' interests. Given the multifaceted nature of student satisfaction, traditional statistical methods alone may not capture the complex interactions between variables. Therefore, this study incorporates machine learning-specifically the Random Forest algorithm-as an analytical tool to uncover

the underlying patterns in the data and to determine the most influential factors affecting student satisfaction.

The basic concept of Random Forest is a supervised machine learning algorithm used for classification tasks and regression. It is an extension of the Decision Tree algorithm that addresses the problem of overfitting commonly encountered in Decision Trees (Breiman, 2001). The working principle of Random Forest involves data sampling, variable selection, and result aggregation. Furthermore, Random Forest is capable of handling large datasets and complex relationships within the data effectively. It can also evaluate feature importance to identify the factors that influence the outcomes.

The application of Random Forest in the educational context can enhance data analysis and assist in decision-making for designing and developing teaching strategies. For example, Beulac and Rosenthal (2019) used Random Forest for predictive analysis to study students' academic progress in higher education, enabling the identification of students at risk of low academic progression, thus improving support for them. Similarly, Yu (2021) applied Random Forest to predict the success of online learning, leading to improvements and refinements in online teaching methods for greater effectiveness.

Additionally, Random Forest is also capable of classifying various factors. Zhang et al. (2021) examined factors influencing students' satisfaction with online learning during the COVID-19 pandemic using the Random Forest algorithm. Related research indicates that applying this algorithm enables efficient data analysis, leading to new insights and contributing to educational knowledge. In this study, the Random Forest algorithm is used to investigate factors influencing student satisfaction with random classroom activities.

Instructional Design Framework

The instructional design framework for the technique of organizing random activities in the classroom based on students' interests consists of 3 key components: teacher, students, and educational technology, as shown in Fig 1.

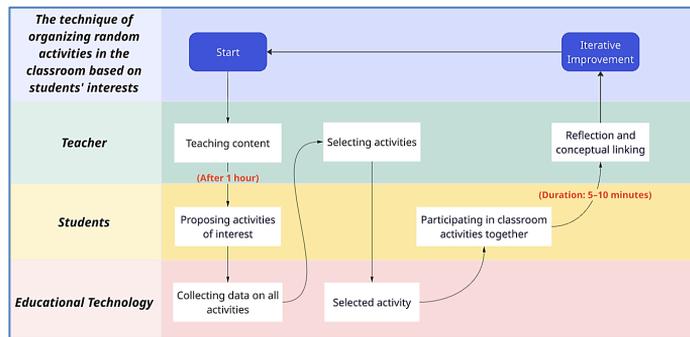


Fig. 1 instructional design framework for the technique of organizing random activities in the classroom based on students' interests.

Although the activities are randomly selected, they are pedagogically structured to support learning objectives rather than serving as mere recreational breaks. Each activity is designed to stimulate cognitive engagement, promote peer interaction, and activate prior knowledge related to the lesson content. The post-activity phase emphasizes conceptual reflection and knowledge integration, ensuring alignment with Active Learning principles. The process of organizing random activities in the classroom based on students' interests consists of the following steps:

1) Start: This marks the beginning of the lesson and serves as the initial stage of the teaching process.

2) Teaching content: The teacher presents the lesson content through lectures, demonstrations, or scenario-based simulations.

3) Proposing activities of interest: After an hour of content delivery, students propose activities in which they are interested. The proposed activities must be engaging, relevant, appropriate for the classroom environment, and free from excessive constraints, following the principles and theories discussed earlier to ensure effective implementation.

4) Collecting data on all activities: Students submit their proposed activity names through a Learning Management System (LMS) in a virtual classroom prepared by the instructor.

5) Selecting Activities: The teacher collects all proposed activities submitted by students, then reviews and screens them based on specific

criteria-such as feasibility within a 5-10 minute timeframe, appropriateness for the classroom context, and encouragement of creativity. The shortlisted activities are then prepared for the random selection process.

6) Selected activity: The teacher uses educational technology, such as a spinning wheel application, to input the selected activities into the system, which then randomly selects one to be implemented that week.

7) Participating in classroom activities together: All students engage in the randomly selected classroom activity, promoting collaboration and Active Learning.

8) Feedback and Reflection: After completing the activity, students provide feedback regarding engagement, relevance, and perceived learning value. The instructor analyzes this feedback to refine and update the activity database for future sessions.

9) Iterative Improvement: The refined activity database is then used to inform the selection and design of subsequent random classroom activities, creating a continuous improvement cycle.

Research Methodology

This research methodology consists of the following steps: (1) research participants, (2) research design, (3) data collection, and (4) data analysis.

Research Participants

The participants of this study were 66 undergraduate students of the Faculty of Agricultural Technology, Surin Campus, Rajamangala University of Technology Isan, in the first semester of the academic year 2024. Purposive sampling was used based on their course enrollment, as follows:

- 1) Digital Media Design and Development, 14 students
- 2) Computer-Assisted Instruction, 8 students
- 3) Data Structures and Algorithms, 14 students
- 4) Special Topics in Computer Science, 11 students
- 5) Selected Topic Development, 19 students

Research Design

The researcher conducted an experiment based on an experimental design in the form of a One-Shot Case Study design, as shown in Table 1.

Table 1 Experimental Design Used in Research

Group	Pre-Test	Intervention	Post-Test
E ₁	-	X	O ₁

Where:

E₁ represents the experimental group, 66 students.

X represents the intervention using the developed framework for random class activity management based on students' interest.

O₁ represents the post observation after the experiment.

Data Collection

This research was approved for ethical clearance under the human ethics approval number HEC-03-67-007. After completing the preparation of the learning environment and all related tools, the researcher started the study on June 20, 2024, and completed it on August 20, 2024. The instructional time was 4 hours per week for a total of 8 weeks. Before the beginning of the experiment, the researcher had explained to all participants the teaching approach using the random class activity management technique based on students' interests. The experiment was conducted according to the developed framework. After the experiment was completed, the researcher collected data using a student satisfaction survey on the random class activity management technique based on students' interests. The survey was divided into three parts: 1) general information including gender, computer affinity, devices, and teaching method affinity, 2) student satisfaction, and 3) suggestions regarding the strengths and weaknesses of the technique. The researchers included only completed surveys, resulting in a total of 60 out of 66 surveys being considered for analysis.

Data Analysis

The researcher analyzed the students' satisfaction data using content analysis and statistical descriptives, including frequency, percentage, mean, and standard deviation. The Random Forest algorithm is used to examine the factors that influence students' satisfaction with random classroom activities.

Results

This study examines students' satisfaction with the randomized classroom activity technique, which incorporates educational technology to support Active Learning. The results are outlined below.

1. Student Demographics and Satisfaction with the Random Activity Management Technique

Table 2 General Information

List	Total	
	Student	Percentage
1. Gender		
Male	34	56.67
Female	24	40.00
Not Specified	2	3.33
2. Computer Affinity		
Satisfied	49	81.67
Unsatisfied	0	0.00
Neutral	11	18.33
3. Devices		
Personal Computer	7	11.67
Laptop	42	70.00
Smartphone	1	1.67
Using More than One Device	10	16.66
4. Teaching Method Affinity		
Traditional Teaching	6	8.00
Collaborative Learning	9	12.00
Practical-based Learning	22	29.30
Blended Learning	23	30.70

From Table 2, it was found that the total participants were divided into 34 males, accounting for 56.67%, and 24 females, accounting for 40.00%. Regarding interest in computers, 49 participants reported a high level of interest in computer-related topics, accounting for 81.67%, while 11 participants expressed a neutral attitude, representing 18.33%. In terms of devices used for learning, the most used device was a laptop, with 42 participants, accounting for 70.00%. Additionally, the most preferred teaching method was Blended Learning, with 23 participants, accounting for 30.70%. This was followed by Practice-based

Learning with 22 participants, making up 29.30%. Collaborative Learning was the next preference, with 9 participants, accounting for 12.00%, and the least preferred method was Traditional Teaching, with 6 participants, accounting for 8.00%.

Table 3 Results of student satisfaction evaluation using a five-point Likert scale for the random activity management technique based on students' interests

Item	Total (n=60)		
	\bar{X}	SD	Level of satisfaction
1. Promoting student participation	3.80	1.07	high
2. Promoting student interest in learning	3.87	1.08	high
3. Promoting student focus in learning	3.77	1.09	high
4. Creating enjoyment in the classroom	3.81	1.09	high
5. Reducing stress from prolonging learning sessions	3.75	1.16	high
Total	3.80	1.08	high

Table 3 shows the overall rating of student satisfaction using a 5-point Likert scale regarding the technique of managing classroom activities randomly based on student interests. The results show that overall students expressed a high level of satisfaction with a mean of 3.80 and a standard deviation of 1.08. When analyzing individual items, the highest rated aspect was "Promoting student interest in learning," with a mean of 3.87 and a standard deviation of 1.08. This was followed by "Creating enjoyment in the classroom" with a mean of 3.81 and a standard deviation of 1.09, and "Promoting student participation" with a mean of 3.80 and a standard deviation of 1.07.

2. Student Perspectives on the Technique of Randomly Managed Classroom Activities

The researcher analyzed students' feedback on the technique of randomly managed classroom activities based on their interests. This analysis, derived from open-ended responses in the satisfaction survey, was categorized into two main themes:

Positive Attitudes

The majority of students reported that this technique effectively reduced stress from prolonging learning sessions, creating a more relaxing and enjoyable classroom environment. They highlighted that activities generated from student suggestions enhanced engagement and enjoyment. In addition, students noted that randomized activities increased their interest in attending future classes, leading to higher participation and motivation.

Negative Attitudes

Some students felt that the frequency of activities was excessive, suggesting that weekly activities might not be ideal. They observed that frequent activities occasionally disrupted their focus, making it more challenging to retain academic content.

3. Data Analysis Using the Random Forest Algorithm to Study Factors Affecting Student Satisfaction

The dataset consisted of 60 student satisfaction responses, which covered six variables: gender, computer affinity, cumulative GPA, preferred learning methods, subject, and pre-class preparation. The data preparation process involved verifying completeness and cleaning the dataset by removing inconsistent records and entries with missing values.

The cleaned dataset was then transformed into a format suitable for analysis using the selected algorithm. The satisfaction scale was stratified using equal-interval classification to ensure methodological transparency and to avoid bias in class distribution. Each category spans an equal range of 1.33 points on the five-point Likert scale. Students' satisfaction scores were categorized into three levels:

Scores between 1.00 and 2.33 were labeled as "Poor".

Scores between 2.34 and 3.67 were labeled as "Fair".

Scores between 3.68 and 5.00 were labeled as "Good".

Subsequently, the data was split into a training set (70%) and a test set (30%) using the Random Forest algorithm for analysis. This approach ensured that the data was well structured and prepared for predictive modelling and factor analysis.

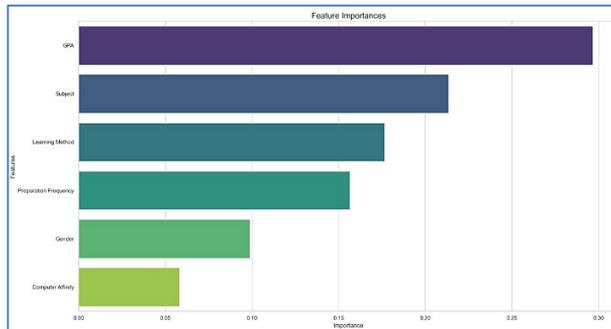


Fig. 2 Variables Importance Plot Highlighting Key Factors Influencing Student Satisfaction

According to Figure 2, the analysis using the Random Forest algorithm identified the importance of various features in predicting student satisfaction. The results revealed that GPA was the most significant predictor, with an importance score of 0.29. The second most significant feature was Subject, with an importance score of 0.21, followed by Teaching Method, with an importance score of 0.18, and Preparation for Class, with an importance score of 0.16. The feature with the lowest importance was Gender, with an importance score of 0.10, and Computer Affinity, with an importance score of 0.06. These findings highlight the varying levels of influence that each feature has on students' satisfaction, providing insights into key factors that educators can target for improvement.

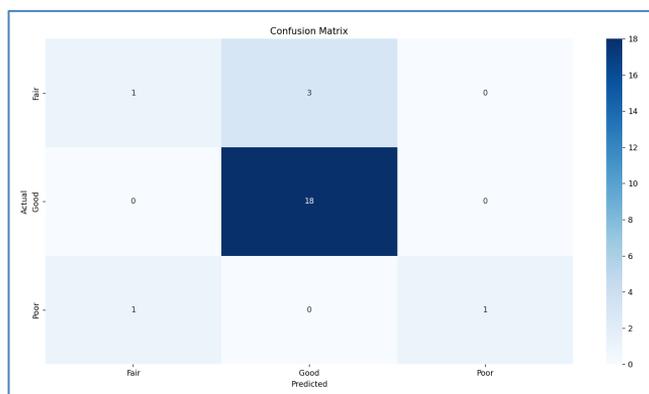


Fig. 3 Confusion Matrix Representing Model Predictions

From Figure 3, the model's performance metrics for each class are as follows:

Class 0 (Fair): Precision = 0.50, Recall = 0.25, F1-Score = 0.33

Class 1 (Good): Precision = 0.86, Recall = 1.00, F1-Score = 0.92

Class 2 (Poor): Precision = 0.00, Recall = 0.25, F1-Score = 0.33

The model achieved an overall accuracy of 83.33%, demonstrating strong predictive performance for the majority class (Good) but struggling with less frequent classes (Fair and Poor). These results suggest that further model tuning, such as class balancing or alternative classification techniques, may enhance its performance across all categories.

Discussion

This research explored a framework for implementing randomized classroom activities tailored to the interests of undergraduate students, supported by educational technology, and rooted in Active Learning principles. The goal was to increase student engagement and interest in learning. The findings are discussed below:

1) Student Satisfaction, the experimental results revealed that overall students' satisfaction was high, with a mean of 3.80 and a standard deviation of 1.08. The dimensions with the highest satisfaction scores, ranked in order, were: 1) Promoting student interest in learning, 2) Creating enjoyment in the classroom, 3) Promoting student participation, 4) Promoting student focus in learning, and 5) Reducing stress from prolonging learning sessions. The high level of satisfaction can be attributed to the randomized classroom activities tailored to students' interests, which were directly relevant to the learners. This alignment led most students to actively engage in the activities during each session. Additionally, these activities fostered social skills, as students interacted more frequently with their classmates during the activities. For instance, storytelling activities centered on mysterious phenomena in the classroom received significant attention. This success stemmed from the alignment of the activity topic with the students' existing interests. Once the activity began, students demonstrated attention and active listening. When the activity concluded, the instructor could transition seamlessly into the lesson because students were already attentive

and focused on the class. This observation aligns with the ideas proposed by Miller et al. (1988), who suggested that creating situations where students perceive the topic as personally relevant increases their engagement in activities. Furthermore, Ainley (2012) explained that students' pre-existing interests significantly influence their engagement in activities. When an activity is closely related to their interests, students are more likely to participate without hesitation. Additional evidence from the evaluation responses indicates that these randomized activities were effective in enhancing motivation. Students noted that the activities were enjoyable because they could participate in suggesting activity ideas. The surprise of learning about the weekly activity sparked excitement, further motivating them to engage actively. While the activities introduce elements of enjoyment and novelty, they differ fundamentally from traditional brain breaks by being intentionally designed to reinforce learning concepts and sustain cognitive engagement rather than interrupt it.

2) Factors Influencing Students' Satisfaction, the study found that the most significant factor influencing students' satisfaction was the GPA, which had the highest importance value of 0.29. This result highlights that students' academic performance and learning ability play a crucial role in determining their level of satisfaction. Students with higher GPA tend to exhibit a more positive attitude toward the learning process and are more likely to feel satisfied. This finding aligns with Moore's (2018) research, which identified a significant positive correlation between GPA and students' satisfaction. Furthermore, Walker-Marshall and Hudson (1999) emphasized that GPA is one of the most influential factors affecting students' satisfaction. Similarly, Grayson (2004) corroborated that student satisfaction is related to both GPA and the teaching methods employed by instructors. However, the researcher emphasized that the most critical factor affecting students' satisfaction is their underlying personality characteristics. In addition to GPA, secondary factors influencing student satisfaction included course subjects and teaching methods. These findings underscore the importance of the relevance of course content and the instructor's approach to delivering knowledge. Specifically, teaching methods tailored to meet the needs of students play a significant role in enhancing satisfaction levels. Flexible and adaptive

teaching strategies can contribute to a more engaging and fulfilling learning experience for students.

An additional consideration emerging from this study is the potential role of learning readiness in shaping student responses to randomized classroom activities. Students with higher GPA levels may exhibit greater adaptability, self-regulation, and tolerance for uncertainty, enabling them to engage more positively with dynamic and unpredictable learning formats. In contrast, students with lower GPA levels may prefer more structured and predictable learning environments that demand less sustained engagement. These differences suggest that the effectiveness of randomized active learning strategies may vary across learner profiles. Consequently, instructional designs should consider flexible implementation approaches to accommodate diverse readiness levels. Future research should further investigate learning readiness as a moderating factor in technology-supported active learning environments.

Interestingly, computer affinity exhibited the lowest feature importance score (0.06), which contrasts with common assumptions regarding technology-supported learning interventions. This finding may be attributed to the simplicity and intuitive design of the spinning wheel application, which requires minimal technical proficiency. As a result, students with varying levels of computer familiarity were able to engage with the activity equally, reducing the influence of computer affinity on satisfaction outcomes. From a learning design perspective, this aligns with principles of universal design for learning (UDL) and reduced extraneous cognitive load, where tool usability minimizes technical barriers and allows learners to focus on the activity itself rather than the technology.

Although the intervention generally enhanced student engagement, qualitative feedback indicated that some learners perceived the frequency of random classroom activities as excessive and occasionally disruptive to their concentration. From the perspective of cognitive load theory, frequent activity interruptions may introduce extraneous cognitive load, particularly during cognitively demanding lessons. This suggests that the effectiveness of such activities is contingent not only on their content but also on their timing and frequency. To maintain an optimal balance between classroom enjoyment and academic focus, future implementations should consider reducing the activity

frequency (e.g., bi-weekly) or aligning activities with natural instructional transitions. These insights provide practical guidance for refining active learning designs to maximize engagement while minimizing cognitive disruption.

In this study, Random Forest was primarily utilized as an exploratory analytical tool to identify key contributing factors and interaction patterns related to student satisfaction, rather than as a final predictive model. The active learning method, implemented through randomized classroom activities tailored to students' interests, increases engagement, improves concentration, and reduces stress, resulting in high levels of student satisfaction. At the same time, this approach allows instructors to manage classrooms more effectively and deliver content more efficiently. Such a method offers a viable solution to student engagement issues. However, the successful implementation of this method depends on several factors, including grade point average (GPA), course content, teaching methods, and the unique individual characteristics of the students. Therefore, the design of activities should be tailored to the interests and individual characteristics of students in different learning contexts in order to maximize the effectiveness of the instructional process.

Suggestion

Limitation

The data collected for analysis revealed that the number of responses indicating low and moderate levels of satisfaction was relatively small, which may result in lower accuracy in the analysis of Class 0 (Fair) and Class 2 (Poor). The model's limited ability to accurately predict low-satisfaction students highlights a critical limitation of applying classification algorithms to small and imbalanced educational datasets. Consequently, the predictive results should be interpreted with caution, particularly for identifying at-risk or dissatisfied learners.

Recommendations

The research findings indicate that Grade Point Average (GPA), which reflects students' prior interest in learning, as well as their underlying individual characteristics, plays a more significant role in influencing learning outcomes than the teaching methods chosen by instructors. Therefore, the development of learning enhancement strategies should focus on strengthening the internal

potential of students, particularly by designing activities or learning strategies that align with their interests and individual characteristics. This approach would help stimulate intrinsic motivation and promote the sustainable development of learning skills.

Future Work

1) Future studies should consider complementing machine learning approaches with traditional inferential statistics, such as regression analysis, to validate and triangulate the observed relationships using larger datasets.

2) Future studies should explore data balancing techniques, such as Synthetic Minority Over-sampling Technique (SMOTE), to improve model sensitivity toward minority satisfaction classes.

References

- Ainley, M. (2012). Students' interest and engagement in classroom activities. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), **Handbook of Research on Student Engagement** (pp. 283–302). Springer.
- Beulac, C., & Rosenthal, J. S. (2019). Predicting university students' academic success and major using random forests. **Research in Higher Education**, **60**, 1048–1064.
- Breiman, L. (2001). Random Forests. **Machine Learning**, **45**(1), 5–32.
- Burrowes, P. A. (2003). A student-centered approach to teaching general biology that really works: Lord's constructivist model put to a test. **The American Biology Teacher**, **65**(7), 491–502.
- Cickovska, E. (2020). Understanding and teaching Gen Z in higher education. **Horizons International Scientific Journal. Series A: Social Sciences and Humanities**, **26**(3), 275–290.
- Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. **Journal of Personality and Social Psychology**, **18**(1), 105–115.
- Dinkel, D., Schaffer, C., Snyder, K., & Lee, J. M. (2017). They just need to move: Teachers' perception of classroom physical activity breaks. **Teaching and Teacher Education**, **63**, 186–195.

- Drigas, A. S., & Angelidakis, P. (2017). Mobile applications within education: An overview of application paradigms in specific categories. **International Journal of Interactive Mobile Technologies**, 11(4), 17–29.
- Duhaney, D. C., & Zemel, P. C. (2000). Technology and the educational process: Transforming classroom activities. **International Journal of Instructional Media**, 27(1), 67–72.
- Fullan, M. (2013). The new pedagogy: Students and teachers as learning partners. **Learning Landscapes**, 6(2), 23–29.
- García-Morales, V. J., Garrido-Moreno, A., & Martín-Rojas, R. (2021). The transformation of higher education after the COVID disruption: Emerging challenges in an online learning scenario. **Frontiers in Psychology**, 12, 1–6.
- Gentry, M., Gable, R. K., & Rizza, M. G. (2002). Students' perceptions of classroom activities: Are there grade-level and gender differences?. **Journal of Educational Psychology**, 94(3), 539–544.
- Grayson, J. P. (2004). The relationship between grades and academic program satisfaction over four years of study. **Canadian Journal of Higher Education**, 34(2), 1–34.
- Higgins, E. T. (2000). Making a good decision: Value from fit. **American Psychologist**, 55(11), 1217–1233.
- Izard, C. E. (2007). Basic emotions, natural kinds, emotion schemas, and a new paradigm. **Perspectives on Psychological Science**, 2(3), 260–280.
- Johnson, R. T., & Johnson, D. W. (2008). Active learning: Cooperation in the classroom. **The Annual Report of Educational Psychology in Japan**, 47, 29–30.
- McMullen, J., Kulinna, P., & Cothran, D. (2014). Physical activity opportunities during the school day: Classroom teachers' perceptions of using activity breaks in the classroom. **Journal of Teaching in Physical Education**, 33(4), 511–527.
- Michael, J. (2006). Where's the evidence that active learning works?. **Advances in Physiology Education**, 30(4), 159–167.

- Miller, K. A., Deci, E. L., & Ryan, R. M. (1988). Intrinsic motivation and self-determination in human behavior. **Contemporary Sociology**, 17(2), 253–257.
- Moore, T. (2018). **An examination of satisfaction, GPA, and retention of first-year college students from rural communities at a small public technical college**. Doctoral dissertation, St. John Fisher University.
- Muthuprasad, T., Aiswarya, S., Aditya, K. S., & Jha, G. K. (2021). Students' perception and preference for online education in India during COVID-19 pandemic. **Social Sciences & Humanities Open**, 3(1), 1–11.
- Prince, M. (2004). Does active learning work? A review of the research. **Journal of Engineering Education**, 93(3), 223–231.
- Seemiller, C., & Grace, M. (2017). Generation Z: Educating and engaging the next generation of students. **About Campus**, 22(3), 21–26.
- Taneja, A., & Dutt, I. (2021). COVID-19 and its implications on students' learning behaviour. **Library Philosophy and Practice**, 1–15.
- Walker-Marshall, A., & Hudson, C. M. (1999). Student satisfaction and student success in the University System of Georgia. **Association for Institutional Research Report**, 1–16.
- Yu, J. (2021). Academic Performance Prediction Method of Online Education using Random Forest Algorithm and Artificial Intelligence Methods. **International Journal of Emerging Technologies in Learning (Online)**, 16(5), 45–57.
- Zhang, Y., Zhang, P., Yang, H., Zhao, K., & Han, C. (2021). Influencing factors of students' online learning satisfaction during the COVID-19 outbreak: An empirical study based on random forest algorithm. In **International Symposium on Emerging Technologies for Education** (pp. 103–114). Springer International Publishing.