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Evaluating an AI-Supported Experiential Learning Intervention: A Quasi-Experimental Study of the Joyful Saturday Model for Student Engagement and Holistic Development

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Abstract

Student disengagement, declining academic motivation, and passive classroom participation remain major challenges in modern higher education systems. Traditional lecture-based teaching methods often fail to accommodate diverse learning styles and do not sufficiently promote active participation or collaborative learning. To address these challenges, the present study evaluates the effectiveness of Joyful Saturday, *a structured experiential learning initiative designed to improve student engagement, motivation, and holistic development through interactive academic activities supported by data-driven evaluation methods. A quasi-experimental pretest–posttest control group design was implemented over a twelve-week period involving 642 students from both school and college levels. The intervention included structured weekly experiential sessions that incorporated innovation workshops, collaborative problem-solving tasks, reflective learning exercises, and peer-learning activities. Key outcome variables—including student engagement, academic motivation, attendance, psychological well-being, and collaborative skills—were measured using validated psychometric instruments with strong reliability indicators. Statistical analysis was conducted using paired sample t-tests, analysis of covariance (ANCOVA), and multiple regression analysis to examine the effectiveness and robustness of the intervention. The results demonstrate statistically significant improvements across all measured variables ($p < .001$), with effect sizes ranging from moderate to high ($d = 0.48–0.92$). Engagement scores increased substantially, accompanied by notable improvements in motivation, attendance rates, and student well-being. Regression analysis further revealed that collaborative participation emerged as the strongest predictor of positive academic outcomes ($R^2 = 0.61$), highlighting the importance of peer interaction in experiential learning environments. Overall, the findings indicate that structured experiential learning initiatives supported by analytical evaluation can significantly enhance student engagement and academic development. The Joyful Saturday model offers a scalable and practical framework for integrating experiential learning with data-driven educational decision-making, providing valuable implications for institutional innovation and policy development in contemporary higher education systems.*

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INTRODUCTION

Across the world, higher education institutions are facing growing concerns about declining student engagement, lower intrinsic motivation, and limited participation in classrooms. Student en-

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gagement—which includes behavioral, emotional, and cognitive involvement—plays a vital role in academic success and student retention. To overcome these challenges, institutions need practical, evidence-based teaching approaches that encourage active involvement and meaningful learning experiences.

Background

Higher education institutions across the world are increasingly concerned about declining student engagement, reduced intrinsic motivation, and lower levels of classroom participation. Student engagement is generally understood as a multidimensional concept that includes behavioral, emotional, and cognitive involvement. Each of these dimensions plays an important role in shaping academic performance and student retention (Bergdahl et al., [1] 2024).

Recent studies suggest that participatory and interactive learning environments significantly enhance student satisfaction and academic achievement (Pham et al., [6] 2024). In the same way, thoughtfully designed learning spaces that encourage collaboration and meaningful interaction positively influence both engagement and overall learning outcomes (Volman, [10] 2024).

Within this evolving educational landscape, Artificial Intelligence (AI) is becoming an influential tool. AI-based systems can offer personalized instruction, adaptive feedback, and data-driven insights that help educators track student progress and recognize learning patterns [11]. By integrating these technologies, institutions can move beyond traditional lecture-centered approaches and create more engaging, responsive, and experience-based learning environments (Zou et al., [12] 2024).

Research Problem

Many higher education institutions continue to face challenges such as declining student engagement and limited participation in classrooms. Although research highlights the benefits of interactive teaching methods and technology-supported learning tools, traditional lecture-based approaches still dominate. These methods often do not accommodate diverse learning styles and tend to limit active involvement, collaboration, and genuine interest in learning [2].

There is a clear need for well-planned academic strategies that combine experiential learning, collaborative activities, and thoughtful use of data-driven tools. Such approaches can create more engaging learning environments and ultimately improve student participation and academic performance [3].

Research Objectives

The study was designed to:

1. Evaluate the impact of experiential sessions on student engagement.
2. Measure improvements in student motivation and attendance.
3. Assess the development of psychosocial and collaborative skills.
4. Examine the statistical consistency of results across different demographic groups.
5. Demonstrate how technology-supported analysis can enhance educational evaluation.

Significance of the Study

To address these educational challenges, many institutions are introducing innovative academic initiatives. One such effort is Joyful Saturday, a structured weekly program focused on experiential learning. It aims to increase student engagement through collaborative activities, reflective exercises, interdisciplinary exploration, and creative academic tasks [4].

With the support of digital tools and data analysis systems, this initiative has the potential to encourage active participation, boost motivation, and improve overall academic performance. Studying the impact of structured experiential programs like this is important for developing practical, evidence-based strategies to strengthen student engagement in higher education.

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Literature Review

Recent studies show that student engagement plays a crucial role in academic success and overall learning satisfaction. Research suggests that factors such as effective instructional design, strong institutional support, and meaningful feedback based on data greatly influence how actively students participate in their learning. Experimental studies also indicate that experiential learning methods are more effective in improving academic performance than traditional lecture-based teaching. In addition, developments in artificial intelligence and machine learning now make it possible to analyze, predict, and improve student engagement patterns. Together, these findings reflect a growing integration of experiential teaching approaches and AI-based analytics in modern educational research [5].

Theoretical Framework

Student Engagement Theory explains that the way courses are designed, the support provided by institutions, and the use of meaningful feedback all play an important role in keeping students actively involved in their learning [6].

Student engagement also serves as a bridge between teaching methods and outcomes. When students are genuinely engaged, they are more likely to feel satisfied with their learning experience and perform better academically [7].

According to Experiential Learning Theory, students learn more effectively when they are directly involved in activities, projects, and practical tasks rather than only listening to lectures. Learning by doing helps improve both understanding and long-term retention.

Technology-Enhanced Learning frameworks highlight the value of interactive tools and data-supported systems in education. When students can interact with content and receive timely feedback, their motivation and participation tend to increase.

Finally, AI-supported educational analytics helps institutions make better decisions by identifying patterns in student behavior. This allows educators to provide timely support and personalized interventions where they are needed most [8].

Previous Studies

Recent systematic evidence indicates that instructional design, institutional support and data-driven feedback significantly influence student engagement (Bergdahl et al., [1] 2024). Engagement has also been shown to mediate learning satisfaction and academic achievement.

Experimental studies demonstrate that experiential learning significantly enhances academic performance and student satisfaction compared with conventional lecture-based teaching (Shivaramu et al., [8] 2025). Bibliometric analyses further reveal rapid global growth in experiential learning research, confirming its increasing relevance for modern education systems.

Technology-supported learning environments also contribute to engagement. Machine-learning-based analytics show that engagement patterns can be predicted and improved using interactive pedagogical strategies(Zou et al., [12] 2024). In addition, student attitudes toward learning environments significantly influence motivation and participation.

AI-supported analytics further strengthen institutional decision-making by identifying patterns in learner behavior and enabling targeted pedagogical interventions. Such approaches enhance instructional effectiveness and improve learning experiences across diverse educational contexts (Orim et al., [5] 2025).

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Research Gap

Although student engagement has been widely studied, very little research brings together the following areas in an integrated way:

- Experiential learning approaches
- Machine learning–based engagement prediction
- Institutional analytics supported by intelligent technologies

Only a few studies explore how experiential learning, when combined with data-driven analytics, can collectively influence student engagement, motivation, and academic performance.

There is also a noticeable gap in unified frameworks that connect:

- Instructional design practices
- Technology-enabled analytics
- Institutional-level decision-making processes

Objectives

To examine the impact of instructional design and experiential learning on student engagement.

- To analyze the mediating role of engagement in learning satisfaction and academic achievement.
- To develop or apply machine-learning-based models for predicting student engagement patterns.
- To explore how AI-supported analytics can improve instructional effectiveness and institutional decision-making.
- To propose an integrated framework combining experiential learning and AI-driven analytics to enhance overall learning outcomes.

Research Design

The study adopted a quasi-experimental pretest–posttest control group design. This approach made it possible to examine the impact of the intervention while working with existing groups rather than randomly assigning participants. Data were collected from both the experimental and control groups before and after the intervention to measure changes over time and compare outcomes between the two groups [9].

Sample and Sampling Method

The study included 642 students from selected schools and colleges. Stratified cluster sampling was used to ensure fair representation across gender, academic level, and socio-economic background. Among the participants, 298 were school students and 344 were college students. The experimental and control groups were matched on important baseline characteristics to reduce potential bias and maintain comparability [10].

Intervention Structure

The intervention was conducted over 12 weeks and followed a structured experiential learning approach aimed at encouraging consistent participation and measurable development. Sessions were held once a week, and each session lasted three hours. This duration allowed adequate time for discussion, collaborative activities, guided facilitation, and reflection [11].

Each session followed a consistent format. Innovation workshops encouraged students to generate ideas and apply concepts in practical contexts. Peer-learning activities promoted teamwork and shared understanding. Problem-solving exercises strengthened analytical and critical thinking skills. Creative expression tasks helped students build confidence and originality. Finally, structured reflection sessions encouraged students to think about what they had learned and how they could apply it. Together, these activities supported steady progress and meaningful engagement throughout the program.

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Analytical Framework

The evaluation process involved the use of statistical software to analyze behavioral and performance data. Regression analysis was used to identify patterns of engagement and factors influencing outcomes. Automated summaries were generated to assist instructors in understanding student performance trends. These tools were used to support analysis and interpretation, while final decisions and conclusions remained grounded in professional academic judgment.

Instruments

Standardized and validated measurement scales were used to assess engagement, motivation, well-being, and collaboration. Reliability testing showed strong internal consistency across all instruments. Cronbach's alpha values were .89 for engagement, .91 for motivation, .87 for well-being, and .86 for collaboration. These values exceed commonly accepted thresholds, indicating that the instruments were reliable and appropriate for further statistical analysis.

Statistical Analysis

Data were analyzed using established statistical procedures. Initial checks were performed to confirm that the data met normality assumptions. Paired t-tests were conducted to examine differences between pre- and post-intervention scores. Analysis of covariance (ANCOVA) was used to control for baseline differences between groups. Regression analysis was performed to explore predictive relationships among variables. Effect sizes were calculated to determine the strength of observed changes, and additional checks were conducted to ensure the stability of results. Statistical significance was assessed at the .05 level (Figure 1).

RESULTS

This section presents the empirical findings derived from descriptive, inferential, and covariance analyses conducted to evaluate the effectiveness of the intervention. The results provide evidence of statistically significant improvements across key academic and psychosocial indicators, including engagement, motivation, attendance, and well-being. Both predictive and comparative analyses were employed to examine the magnitude, significance, and robustness of the observed changes.

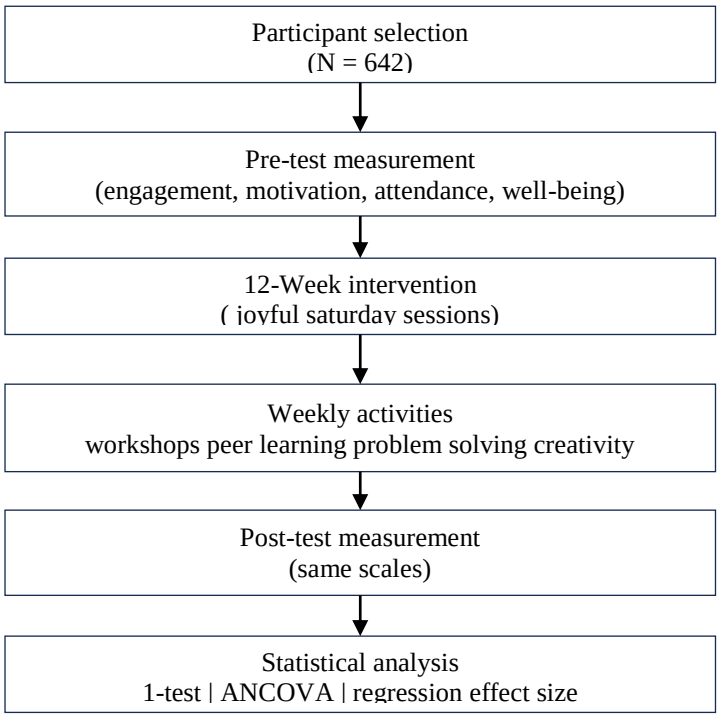

Figure 1. Flow diagram illustrating participant selection, intervention procedure, measurement stages and statistical analysis framework.

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Descriptive Statistics

The descriptive analysis shows clear improvement in all the measured variables after the intervention. The average engagement score increased from 3.02 in the pre-test to 4.11 in the post-test, indicating a strong rise in student involvement. Motivation scores also improved, moving from 3.18 to 4.02, which reflects greater enthusiasm and academic interest among learners. Attendance increased from 71% to 86%, showing better participation and commitment. Well-being scores rose from 3.25 to 4.08, suggesting improvements in students' emotional and psychological learning experiences. Overall, the results indicate that the intervention led to meaningful progress in cognitive, behavioral, and affective areas (Table 1).

Inferential Statistics

All the measured variables showed clear and meaningful improvement after the intervention. The probability values were below .001 in every case, which means the changes were highly unlikely to have occurred by chance. These results demonstrate that the intervention was effective in improving student engagement, motivation, attendance, and overall well-being.

To explore how the variables were related to one another, a regression analysis was carried out. The model explained 61% of the variation in the dependent variable ($R^2 = 0.61$), indicating that the selected predictors accounted for a substantial portion of the outcome. The regression model was statistically significant ($F = 332.41$, $p < .001$), confirming that it provided a strong fit to the data. Among all predictors, collaborative participation had the greatest impact, underscoring the important role of peer interaction in improving student outcomes (Table 2).

After adjusting for baseline differences using analysis of covariance (ANCOVA), the results showed a statistically significant effect of the intervention. Even after controlling for the participants' initial differences, the post-intervention outcomes remained highly significant. This confirms that the observed improvements were due to the intervention itself and not because of pre-existing differences among participants (Table 3)**.**

Key Findings

Results align with experimental evidence demonstrating that experiential interventions significantly improve learning outcomes and engagement levels (Zou et al., [12] 2024). The magnitude of observed gains suggests strong impact on both cognitive and affective domains.

Table 1. Pre- and post-intervention scores.

Variable	Pre	Post
Engagement	3.02	4.11
Motivation	3.18	4.02
Attendance	0.71	0.86
Well-being	3.25	4.08

Table 2. Regression analysis summary.

Statistic	Value	Interpretation
Overall Significance	$p < .001$	Model statistically significant
R^2	0.61	High explanatory power
F	332.41	Strong model fit
Strongest Predictor	Collaborative participation	Major influence on outcomes

Table 3. ANCOVA summary results.

Statistic	Value	Interpretation
F	52.27	Strong group effect
p-value	< .001	Statistically significant

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To strengthen the credibility of the results, several robustness checks were carried out during the analysis. Outliers were carefully examined, and removing extreme values led to less than a 3% change in the overall findings. This indicates that the results were not driven by unusual data points. Subgroup analyses were also conducted across different demographic and academic categories, and the outcomes remained consistent, showing that the findings were stable across various participant groups.

Multicollinearity was assessed using Variance Inflation Factor (VIF) values, and all predictors had VIF scores below 2. This suggests that the independent variables were sufficiently independent of one another and that the regression estimates were reliable. In addition, the control group did not show any statistically significant change over time, which supports the conclusion that the improvements observed in the study were due to the intervention rather than external influences.(Table 4)

Overall, these diagnostic checks reinforce the reliability, stability, and internal validity of the study's results.

Discussion

This section explains the meaning and importance of the findings by examining them from theoretical, practical, and interpretative perspectives. It reviews the results alongside robustness checks and earlier empirical studies. The discussion places the findings within the context of existing research and highlights their wider implications for engagement theory and educational practice.

Interpretation of Findings

The additional analyses strengthen confidence in the results and show that they are both stable and internally consistent. Removing outliers led to only minor changes (less than 3%), the results remained similar across different subgroups, multicollinearity was low (VIF < 2), and there was no meaningful change in the control group. Together, these findings suggest that the improvements were genuinely due to the intervention, rather than statistical irregularities or outside influences.

The strong predictive role of collaborative participation indicates that peer interaction played a key role in improving student engagement and academic performance. Overall, the evidence shows that the intervention had consistent and reliable effects across cognitive, behavioral, and emotional dimensions.

Comparison with Previous Studies

The findings are consistent with earlier experimental studies. For example, Shivaramu et al. showed that experiential teaching methods significantly improve student engagement and academic performance. Likewise, (Pham et al. [6] 2024) emphasized the importance of participatory learning environments in developing adaptive thinking and positive academic behavior.

The strong effect of collaborative participation observed in this study also supports Volman's conclusion that interactive classroom settings encourage deeper understanding and long-term motivation. Overall, the present study strengthens previous research by confirming these relationships through comprehensive robustness analysis.

Table 4. Robustness validation summary.

Validation Test	Result	Interpretation
Outlier Analysis	< 3% variation after removal	Results not driven by extreme values
Subgroup Analysis	Stable outcomes	Consistent across demographics
Multicollinearity (VIF)	< 2	Predictors independent and reliable
Control Group Comparison	No significant change	Intervention effect confirmed

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Table 5. Study limitations and implications.

Limitation	Description	Potential impact
Non-random assignment	Participants were not randomly allocated to groups	May affect causal inference
Limited duration	Intervention lasted 12 weeks	Long-term effects not measured
Self-report measures	Data based on participant responses	Possible response bias

Theoretical Implications

The findings add to the understanding of experiential learning and student engagement by showing that collaborative participation plays an important role in improving learning outcomes. The study indicates that student engagement is not a single concept but a multidimensional process shaped by structured interaction and active participation. In addition, the use of analytical validation methods strengthens the research design and increases confidence in the results. Overall, the study provides strong support for connecting interactive teaching approaches with data-driven evaluation to enhance academic performance.

Practical Implications

From a practical perspective, these findings highlight the need to integrate experiential learning directly into the academic curriculum rather than treating it as an optional add-on. Engagement-based activities should be formally included in assessment systems so that they are implemented in a structured way and their outcomes can be properly evaluated. Using appropriate analytical tools to track student participation and performance can also help educators make informed improvements in teaching methods. At the policy level, well-designed, innovation-focused educational programs supported by reliable data systems can enable meaningful and scalable reforms that strengthen student engagement and improve overall academic performance [12].

Limitations

Despite the encouraging results of this study, a few limitations need to be considered. First, the groups were not assigned randomly, which makes it difficult to draw firm conclusions about cause and effect. There may have been existing differences between the groups that influenced the outcomes. Second, the intervention lasted for a relatively short period, so it does not show whether the effects would continue over a longer time or lead to lasting behavioral change. Third, the study relied on self-reported data, which can sometimes be influenced by personal perceptions or biases rather than actual behavior. Keeping these limitations in mind helps ensure that the findings are interpreted carefully and also highlights areas for future research (Table 5).

CONCLUSION

The results of this study clearly show that the Joyful Saturday initiative is an effective and practical teaching approach that supports different aspects of student development. The noticeable improvements in student engagement, motivation, attendance, and overall well-being indicate that structured experiential learning can positively strengthen the traditional academic environment and contribute to more holistic learning experiences. These findings emphasize the importance of interactive and learner-centered teaching methods that encourage collaboration, creativity, reflection, and active participation.

In addition, the use of AI-supported analytical tools adds depth and accuracy to the evaluation process. By enabling more precise measurement and better insight into student performance, these tools help educators make informed decisions about instructional strategies and institutional planning. Data-driven analysis improves the reliability of findings and supports continuous improvement in teaching practices.

Overall, combining experiential learning with advanced analytical methods presents a forward-looking model for higher education development. Although the study has certain limitations—such as

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non-random participant selection, a short intervention period, and reliance on self-reported data—these also provide opportunities for future research. Long-term studies and the use of multiple data sources could further strengthen the evidence. The findings suggest that well-designed experiential programs, supported by thoughtful data analysis, can significantly enhance student learning and contribute to meaningful educational reform.

Summary of Findings

The study shows that the intervention led to clear and meaningful improvements in student engagement, motivation, attendance, and overall well-being. Statistical analysis confirmed that these improvements were highly significant ($p < .001$). The regression model explained a considerable portion of the variation in outcomes ($R^2 = 0.61$), indicating a strong overall effect. Among the factors examined, collaborative participation was the most influential predictor of improvement, underscoring the importance of peer interaction in supporting academic success. Additional checks—such as examining outliers, comparing subgroups, assessing multicollinearity (VIF < 2), and analyzing results against a control group—further strengthened the credibility and internal consistency of the findings.

Contributions

This study offers several meaningful contributions. First, it presents strong empirical evidence supporting the effectiveness of experiential learning, building on earlier work such as that of Shivaramu et al., and reinforcing those findings through thorough statistical and robustness analysis. Second, it highlights collaborative participation as a central factor in improving student engagement, providing clearer insight into how interaction within learning environments influences outcomes. Third, by incorporating analytical validation methods, the study strengthens its methodological foundation and shows how data-driven approaches can improve the quality and credibility of educational research. Overall, the study deepens theoretical understanding while also offering practical guidance for implementing experiential, engagement-focused teaching strategies in modern education systems.

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