Increasing Student Engagement in Large First-Year Engineering Mechanics: An Evidence-Based Practice Using the Fantasy Mechanics League (FML)

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Abstract - This Complete Evidence-Based Practice paper explores the implementation of the Fantasy Mechanics League (FML) in a first-year Engineering Mechanics course with 1,400 students (300 per lecture hall). FML is a gamified system that rewards active participation in class activities—such as answering questions, spotting mistakes, and completing bonus challenges—to tackle the common challenge of disengagement in large lecture settings. To ensure inclusivity, a flexible platform allows students to interact at their own pace, removing barriers related to public speaking. Additionally, student-led demonstrations (e.g., acting as the professor) foster deeper involvement. Points are tallied throughout the semester; top-ranked students receive structural model kits and handcrafted keepsakes, thereby sustaining motivation.

A mixed-methods approach was employed to evaluate FML's effectiveness in enhancing student engagement, performance, and motivation. Quantitative data indicated that class participation rose from a historically low 3.5% to approximately 27.4% over the semester. Student feedback collected via surveys indicated that 85% of respondents felt FML improved their engagement and understanding. Additionally, an analysis of grade distributions suggests that students in FML-implemented semester achieve higher overall performance compared to previous cohorts. Institutional course evaluations further support these findings, demonstrating increased student satisfaction with course delivery and class climate after FML implementation. Furthermore, a moderate positive correlation ($r = 0.31$) between total FML points and final course grades supports the notion that active participation can boost academic outcomes. By transforming traditional lecture interactions into a competitive yet collaborative framework, FML demonstrates the potential for gamified learning to enrich student experiences in large engineering classrooms. This paper contributes to the growing research on gamification in engineering education and offers insights for practical implementation in large-scale STEM courses.

Keywords: Gamification, Student Engagement, Large Classes, Engineering Mechanics, Active Learning, Classroom Participation, Inclusive Learning, Gamified Learning Strategies, Educational Innovation in STEM.

1. Introduction

Active learning—where students meaningfully engage in tasks, discussions, and problem-solving—has been widely recognized as an effective strategy for improving conceptual understanding and student performance in science, technology, engineering, and mathematics (STEM) fields [1]. Prince defines active learning as any instructional method that encourages students to actively participate in the learning process rather than passively absorbing information through traditional lecturing [1]. Research consistently shows that these methods not only improve academic achievement but also foster higher-order thinking skills, deeper conceptual understanding, and enhanced student motivation [2], [3]. Despite its proven benefits, implementing active learning strategies in large classes can be particularly challenging. Lectures with enrollments often exceeding 250 students create logistical and psychological hurdles to in-depth interaction, immediate feedback, and personalized engagement. Students in large lecture halls may feel anonymous, be reluctant to ask questions, and may perceive fewer opportunities for collaborative problem-solving [4]. Moreover, instructors often struggle to manage time, resources, and varied student needs in such large settings [5].

In recent years, universities have increasingly turned to gamification—introducing game-like elements such as points, badges, and leaderboards into learning activities—to address student disengagement in large classrooms [6]. Modern digital platforms (e.g., interactive polling tools, online quizzes, and classroom response systems) facilitate the application of these elements [7]. When designed appropriately, gamified learning experiences can appeal to diverse learners by providing autonomy, competence, and relatedness—three core needs are identified by self-determination theory [8]. Encouraging students to solve real or simulated problems within a competitive or cooperative environment enhances motivation and promotes sustained engagement, especially when coupled with immediate feedback mechanisms [9].

Beyond gamification, cooperative learning has been identified as a potent strategy for facilitating engagement in large classes. By organizing students into small groups where they work together toward shared goals, cooperative learning fosters both academic and social development [10]. Closely related to this is problem-based learning (PBL), where students learn by solving complex, real-world problems [11]. By merging PBL with gamification and cooperative learning, instructors can create dynamic environments that foster deep learning, critical thinking, and collaboration—even in large, introductory settings [12].

Engineering Mechanics is a foundational course that introduces core concepts such as forces, equilibrium, friction, centroids, and moments of inertia. These topics are crucial for understanding higher-level engineering applications. However, first-year students often find them challenging, especially if the course delivery is primarily lecture-based. Large enrollments exacerbate this challenge, as students might perceive a lack of individualized support and become passive observers rather than active participants. Consequently, the risk of disengagement, poor performance, and attrition is high [5].

To address these challenges, FML—a gamified, cooperative learning model designed for large engineering mechanics classes—was developed by adapting core elements of fantasy sports frameworks, such as the popular Fantasy Premier League (FPL) [13]. Drawing inspiration from FPL's point accumulation systems, leaderboards, and competition-based structure, the FML translates sports-driven engagement strategies into an academic context. The initiative aims to explore the potential of gamified active-learning frameworks to enhance participation in large introductory engineering courses. It also examines the relationship between sustained participation in the FML and improved academic performance, while investigating how various activity types—such as discussions, error correction, and student-led demonstrations—contribute to overall engagement. By aligning these activities with higher-order cognitive objectives as outlined in the revised Bloom's Taxonomy [14], the FML further promotes deeper skill development and critical thinking. By incorporating active learning approaches, gamification elements, and digital platforms such as Menti quizzes, MecSimCalc, and discussion forums, the FML contributes to the growing body of research on evidence-based teaching and inclusive instructional strategies in the digital age [1] – [2], [6].

2. Methodology

2.1. Course and Participant Overview

FML was implemented in a first-year undergraduate Engineering Mechanics course at a large Canadian university. Enrollment in this course typically involves approximately 1,400 students divided among five lecture sections of about 280–300 students each. The large class size posed logistical challenges for personalized instruction, making the gamified framework particularly relevant.

2.2. Study design

A mixed-methods approach was employed to examine participation levels and learning outcomes associated with FML. From a quantitative perspective, weekly participation rates in activities—such as discussions, correcting mistakes, "act-as-professor," demos, Menti Quizzes, and MecSimCalc—were recorded and compiled through platform-generated logs, enabling an assessment of how frequently individual students engaged with the FML elements. Final course scores were then analyzed to investigate any relationships between FML participation points and final grades. Additionally, final grade distributions from sections that used FML were compared with historical (non-FML) data to evaluate the approach's overall effectiveness.

Qualitative data were gathered from multiple sources. Surveys administered in Week 12 captured students' attitudes, motivation levels, and perceptions of FML's effectiveness, while two focus group interviews, each comprising ten participants, offered a deeper examination of student experiences with gamified and cooperative learning elements. Additional insights emerged from a selection of positive feedback emails, which were reviewed to identify recurring themes regarding students' overall impressions, engagement levels, and perceived benefits of the FML approach. Furthermore, standardized end-of-term course evaluation data were reviewed to assess overall student satisfaction and perceptions of course quality in FML versus non-FML contexts.

2.3. Data Analysis

Descriptive statistics served as the primary tool for illustrating engagement patterns. Weekly participation data were presented in bar charts to highlight trends over time, and a pie chart was used to depict the percentage breakdown of FML activities. Pearson's correlation was then employed to assess the association between FML points and final course grades, evaluating whether increased involvement in FML corresponded to higher academic performance.

In terms of qualitative analysis, thematic coding was applied to open-ended survey responses, focus group transcripts, and pertinent email feedback. Recurring themes such as motivation, autonomy, barriers to participation, and perceptions of gamified learning were identified and compiled to provide a nuanced understanding of student experiences.

2.4. Ethical Considerations

Students were informed at the beginning of the course that their feedback and anonymized participation data might be used to evaluate and improve teaching methods. All identifying information was removed prior to analysis, and individual student data was not disclosed in any presentations or publications resulting from this study.

3. Implementation of FML

3.1. Activity Types and Their Integration

FML activities can be categorized into two types: Individual Engagement Activities and Large-Scale Interactive Activities. Individual Engagement Activities involve independent participation, such as responding to in-class discussion prompts, spotting mistakes in lecture examples, and volunteering for 'Act-as-Professor' sessions. These activities encourage personal engagement and critical thinking. In contrast, Large-Scale Interactive Activities involve broader student participation through platforms like Menti Quizzes and MecSimCalc, where students collectively respond to questions or complete structured exercises. These activities aim to increase accessibility and engagement for a larger audience in a lecture setting.

FML's built-in flexibility accommodates the distinct teaching styles and schedules of each lecture section. While certain large-scale activities remain consistent, instructors can adapt individual activities and modify questions, problem-solving techniques, or engagement methods as needed. To ensure fairness, the competition runs independently within each section, preventing any advantage for later classes. A token-based system further enhances adaptability by standardizing the types and frequency of individual activities across sections, while still giving instructors the flexibility to manage class dynamics under a consistent reward structure. Even when Menti Quizzes or MecSimCalc use the same questions across sections, student response patterns remain stable, underscoring FML's capacity to provide equitable, motivating experiences in diverse instructional contexts.

For individual engagement activities, FML introduced an array of activities aimed at enhancing student interaction, critical thinking, and hands-on learning in a large Engineering Mechanics course. One key activity focused on in-class discussions, where students were encouraged to respond to challenging conceptual questions posed by the instructor. These questions often stemmed from real-world mechanics-related scenarios, prompting analytical thinking and fostering group dialogue. To accommodate a range of comfort levels with public speaking, students had the option to engage verbally in real time or submit answers privately through an online forum.

An additional strategy involved deliberately inserting mistakes into lecture examples and inviting students to spot and correct them in exchange for FML points. This approach encouraged sustained attention to detail and discouraged passive notetaking. By consistently monitoring each step for accuracy, participants became more alert to errors and developed stronger problem-solving skills. Similarly, the "Act-as-Professor" method was designed to combat monotony during lengthy examples, as students volunteered to complete subsequent steps in front of the class. This format required the instructor to support volunteers by providing incremental feedback when needed, enabling them to refine both their technical explanations and public speaking skills. Building on this emphasis on active participation, demos were used to illustrate engineering principles in tangible ways. Students took part in brief demonstrations—such as constructing free-body diagrams or visualizing forces acting on physical models—to deepen their grasp of theoretical concepts.

Alongside these in-person activities, two digital platforms expanded the scope of FML to enhance large-scale engagement. The first, MecSimCalc, integrated Python-based simulations or custom quizzes, offering students the chance to practice computational problem-solving at their own pace. Successful completion of these tasks not only reinforced content knowledge but also granted learners additional FML points. The second platform, Menti Quizzes, was deployed to facilitate real-time polling and anonymous question submissions. By allowing students to respond via smartphones, Menti Quizzes ensured that quieter individuals could still participate and receive immediate feedback, thereby promoting inclusivity and mitigating the intimidation often associated with large lecture halls.

From an instructor's viewpoint, implementing these components required additional preparation at the start of the term. Creating Menti Quizzes and designing deliberate mistakes involved extra planning but ultimately streamlined class engagement by prompting continuous student interaction. Instructors noted that the "Act-as-Professor" activity could become time-intensive, but it offered deep insights into students' misconceptions and problem-solving processes. Moreover, setting up and maintaining the leaderboard motivated real-time adjustments to teaching strategies, as instructors used points data to identify under-participating students and encourage them through targeted announcements or personalized feedback.

3.2. Gamification Framework

All FML activities were underpinned by a coherent, individually focused points-based system, updated regularly to maintain a sense of friendly rivalry among students. Each form of engagement—whether spotting a mistake, contributing to discussions, or completing a MecSimCalc quiz—awarded a set number of points. Leaderboards tracked individual progress, motivating students to sustain effort throughout the semester and fostering a sense of community as the cohort tackled course content together.

Students claimed their points through an online FML dashboard, which generated an automated email request to the instructor for approval or rejection. This workflow helped ensure accurate record-keeping and offered timely feedback on submissions. At the semester's conclusion, final prizes were awarded to recognize outstanding engagement. First-place winners received Mola Structural Model kits—providing hands-on opportunities to explore structural engineering concepts—while the top five participants in each lecture section were presented with handcrafted papyrus keepsakes inspired by ancient Egyptian civilization. These accolades served as tangible tokens of accomplishment, underscoring the international spirit of engineering education and celebrating cultural heritage in a meaningful way.

FML participation is entirely voluntary and does not contribute to students' final grades. Instead, it is designed as a motivational tool, where top-performing participants receive small prizes such as structural model kits or handcrafted keepsakes. This approach ensures that participation remains flexible for both students and instructors. Integrating FML into grading would introduce complexity and fairness concerns, as different students engage with the competition in varying capacities. Keeping FML separate from course grades allows for an inclusive and low-pressure environment that encourages engagement without academic penalties.

Finally, reflection and inclusivity elements ensured that all students had opportunities to participate in FML. Individuals who felt uncomfortable presenting in front of large groups could still contribute through Menti quizzes, which rewarded consistent engagement while accommodating a diversity of learning preferences. By blending interactive lecture methods, digital tools, and recognition of top performers, the FML brought a unified, motivating structure to a large and diverse first-year course.

4. Results

4.1. Overall Contributions by Activity

A pie chart (Figure 1) illustrates the proportion of total FML contributions for each activity type across Weeks 1–13. The final aggregated percentages reveal that Menti Quizzes accounted for 56.7% of all recorded contributions, making them the dominant engagement tool. MecSimCalc, a digital platform for interactive problem-solving, followed at 25.9%, indicating strong appeal for students motivated by opportunities to earn additional points through structured tasks. Discussions, which involved students addressing conceptual questions in class or online, reached 9.7%, while Correct Mistakes contributed 5.5%. Two smaller categories—Act-as-Professor (1.0%) and Demos (1.2%)—involved more individualized or small-group participation. Taken together, these last four categories composed approximately 17.4% of total activities, reflecting the value of focused, interactive learning scenarios within a large-class context.

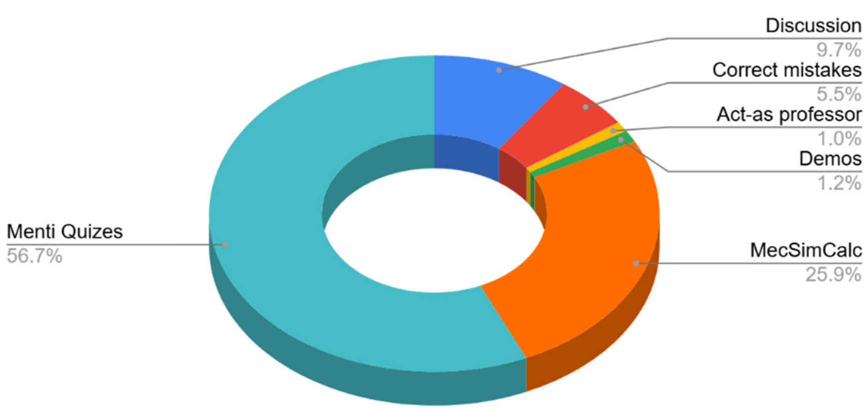

Figure 1. Pie chart of total FML contributions by activity type.

These data suggest that low-stakes, tech-driven quizzes such as Menti Quizzes are highly effective for broad engagement, likely due to their anonymous and immediate-feedback features.

Meanwhile, the success of MecSimCalc underscores the importance of computational practice and the appeal of digital problem-solving platforms. Activities like Discussion, Correct Mistakes, Act-as-Professor, and Demos had lower numerical participation but tended to foster deeper cognitive engagement, collaborative problem-solving, and hands-on demonstrations.

4.2. Weekly Participation Trends

A combined bar chart (Figure 2) displays the ratio of Individual Engagement Activities (blue bars) versus Large-Scale Interactive Activities (red bars) for each week from Weeks 1 to 13. At the start of the semester (Weeks 1–2), individual engagement activities reached approximately 6.1%–5.5%, driven primarily by curiosity and the novelty of the FML approach. Large-scale activities had not yet been implemented during this introductory phase, focusing more on icebreakers and smaller tasks. By Weeks 3–5, individual participation dropped to around 2.3% as midterm exams and increased workloads took precedence, temporarily reducing students' capacity to engage in class or online.

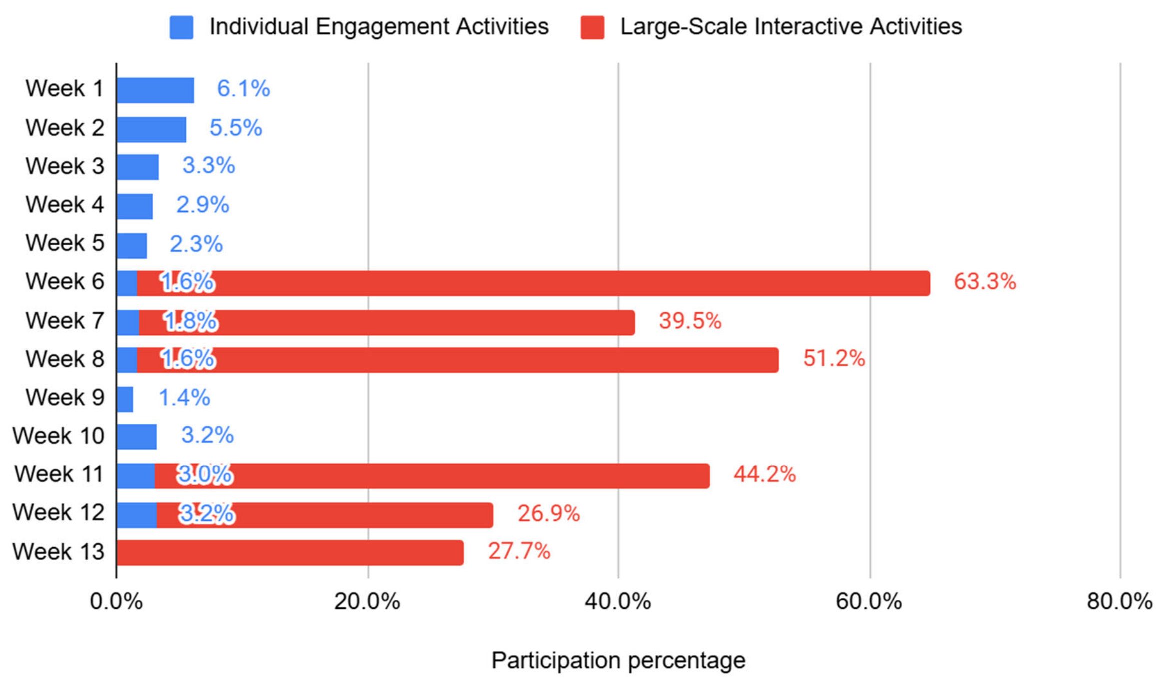

Figure 2. Weekly participation percentage: Individual Engagement (blue) vs. Large-Scale Interactive (red).

In response, instructors decided to introduce large-scale interactive activities (shown by red bars) during Weeks 6–8 providing a fresh incentive for engagement and giving hope to students who had not yet participated. As a result, 40%–60% of the class began taking part in these new initiatives, often motivated by upcoming assessments and the opportunity to boost their FML points. In the final part of the semester (Weeks 11–13), the introduction of more complex Menti and MecSimCalc quizzes further reinvigorated both individual and overall class-wide engagement. Individual activities rebounded to around 3.0%–3.2%, complemented by continued or increased involvement in large-scale exercises.

Overall, participation rose steadily over the semester. Individual engagement activities—including discussions, correcting mistakes, Act-as-Professor, and demos—reached about 27.4% of the class throughout the term, while large-scale activities (Menti Quizzes and MecSimCalc) involved approximately 63.3% of the class. Historically, participation in traditional large lecture settings has been notably low. Based on informal interviews with previous course instructors and personal observations, it was estimated that only approximately 3.5% of students actively engage in class discussions without structured incentives such as gamification or interactive tools. This aligns with broader research indicating that student participation in large lecture environments tends to be minimal due to perceived anonymity and disengagement [1],[4]. Newly introduced, strategically timed, and structured gamification features significantly boosted engagement for this cohort.

While individual engagement was notably higher than in traditional settings, it remained constrained by the limited time available in each lecture session, making it challenging to involve all students in personalized activities. This natural limitation differs from large-scale activities, which allow for broad participation simultaneously. Despite this, the structured integration of individual engagement tasks within FML significantly improved student interaction compared to conventional lecture-based formats.

4.3. Academic Performance Correlation

A Pearson's correlation analysis was conducted to evaluate the relationship between total FML participation points and final course grades. The resulting correlation coefficient ($r = 0.3133$) indicates a weak-to-moderate positive relationship, suggesting that higher involvement in FML activities is modestly associated with better academic outcomes. This finding aligns with broader research linking active participation to improvements in understanding and performance [1], [2], [5]. However, the correlation value also points to the influence of other factors such as prior knowledge, cognitive load, and help-seeking behavior that significantly impact academic performance [15].

Figure 3 illustrates a positive trend between higher FML points and higher final grades for students with moderate to high FML participation. This suggests that active engagement in FML activities may contribute to improved academic performance for these students. On average, participants in FML activities scored 77/100, compared to the overall class average of 73/100, further highlighting the potential benefit of FML engagement. However, for students with low FML points, the correlation is less evident. The data reveals that some high-performing students achieved their results with minimal participation in FML, highlighting that while FML engagement is beneficial, it is not the sole determinant of success. These findings suggest that the impact of FML on academic performance may vary depending on individual student characteristics and learning approaches.

Figure 4 presents the grade distribution for students actively participating in individual FML activities (e.g., discussions or demos). A sizable proportion achieved grades of A– or higher, suggesting that direct engagement in these tasks may bolster academic performance. Nonetheless, the presence of students in lower grade brackets (C+ or below) confirms that individual participation alone does not guarantee success, in keeping with the weak-to-moderate correlation observed.

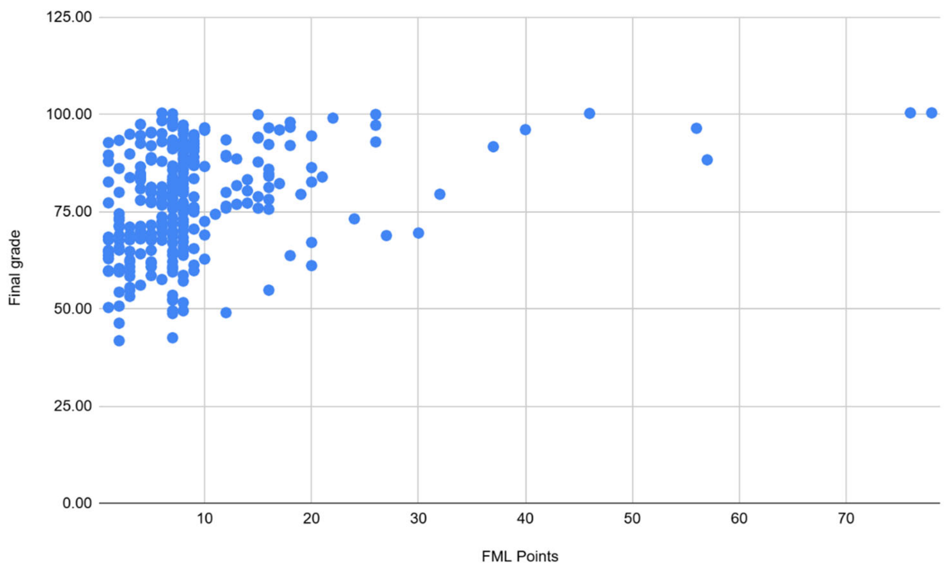

Figure 3. Correlation Between FML Participation and Final Grades.

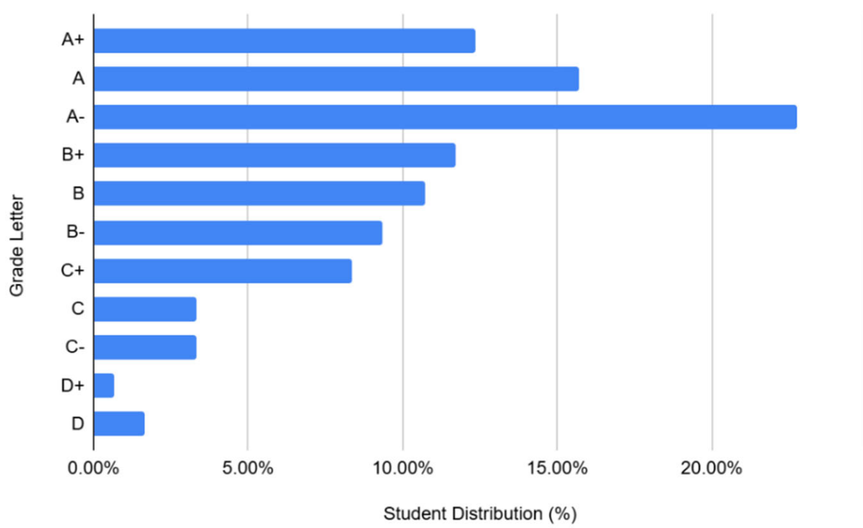

Figure 4. Grade Distribution of Students Participating in Individual FML Activities.

Figure 5 provides an overview of how academic performance correlates with different levels of student engagement in the Fantasy Mechanics League (FML). In parts (a) and (b), the Comprehensive FML Engagement group—those who actively participated in both individual and large-scale activities—earned the highest grades, predominantly in the A– to A+ range. The Predominantly Large-Scale FML Engagement group also performed well but at slightly lower grade tiers, whereas the Minimal FML Engagement group—students who participated infrequently, engaged sporadically, joined side discussions, or completed activities without claiming points—showed a broader distribution with fewer students attaining A– or above. Because large-scale activities (e.g., Menti Quizzes) typically award more points, students who engaged in individual tasks naturally participated in these broader-scale activities as well, eliminating the need for a separate "Predominantly Individual Engagement" category. Together, these findings underscore the positive impact of sustained FML participation on academic success.

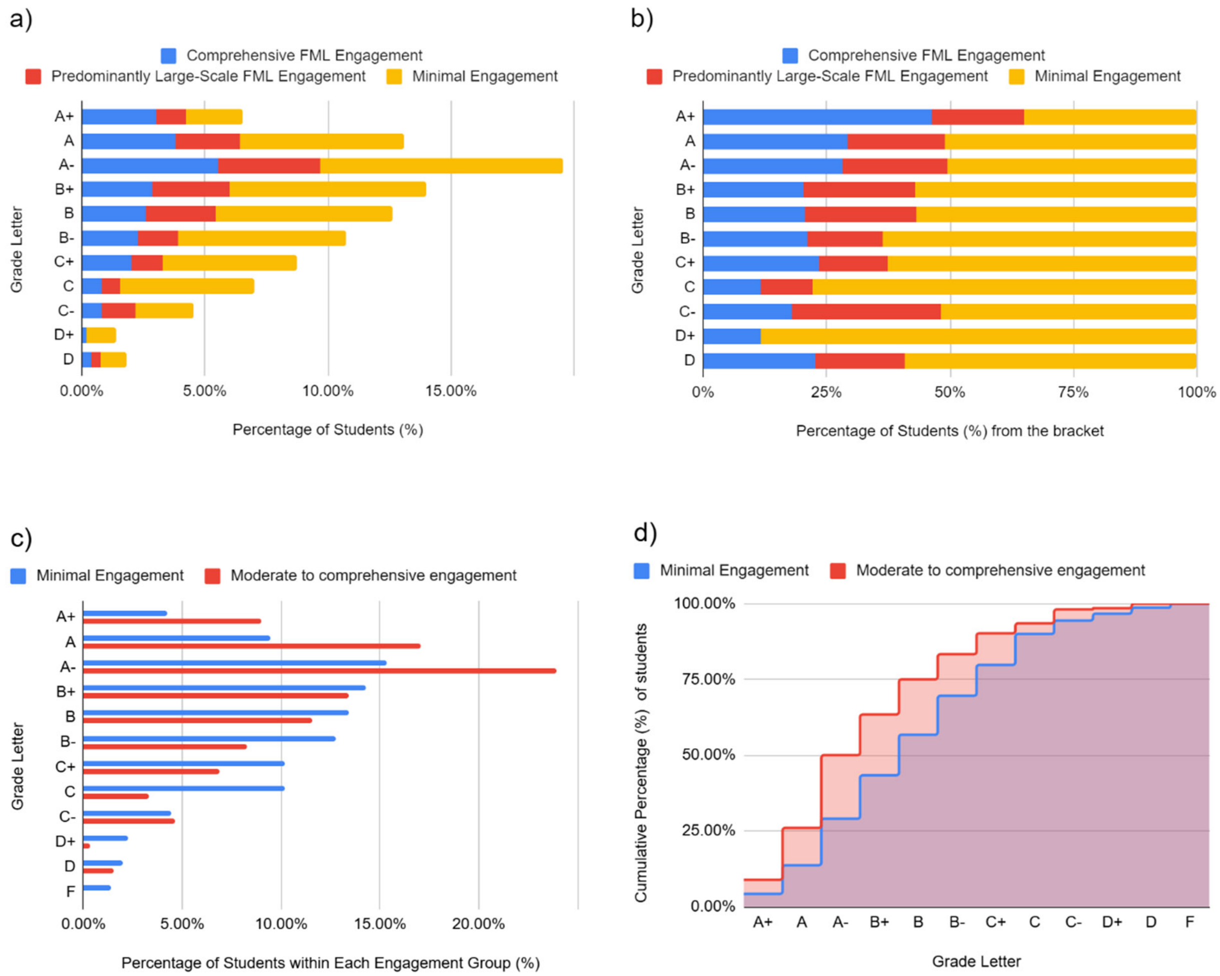

Figure 5. Comparison of Grade Distribution and Engagement Patterns Across FML Participation Categories: a) Grade distribution across three engagement categories; b) Proportional breakdown of students within each engagement category; c) Proportion of students within each engagement category who achieved each letter grade; d) Cumulative percentage of students in each group reaching the specified grade or higher.

Parts (c) and (d) highlight this impact more clearly by comparing the minimally engaged group with the moderate-to-comprehensive group as though each were a separate class. In Figure 5(c), the bars display the percentage of students in each group who attained each letter grade, showing that a substantially higher fraction of moderate-to-comprehensive participants achieved top marks (A– to A+). Figure 5(d) reinforces these results by illustrating the cumulative percentage of students reaching each grade threshold. Taken together, these sub-figures reveal a clear shift toward stronger academic performance among those with higher FML engagement, underscoring how consistent participation in gamified activities can substantially improve grade distributions.

Figure6 compares the overall grade distributions in the course before and after FML. In part (a), the bars represent the percentage of students earning each letter grade under both conditions. Notably, when FML is in place (red bars), a larger proportion of students achieve A-range and B-range grades, while fewer students fall into the lower grade categories. Part (b) reinforces this trend by showing that the cumulative percentage of students achieving each grade or higher is consistently higher with FML (red line), indicating an overall shift toward better performance. These distributions suggest that the implementation of FML may contribute to improving students' academic outcomes by increasing the number of higher achievers and reducing the incidence of failing or near-failing grades.

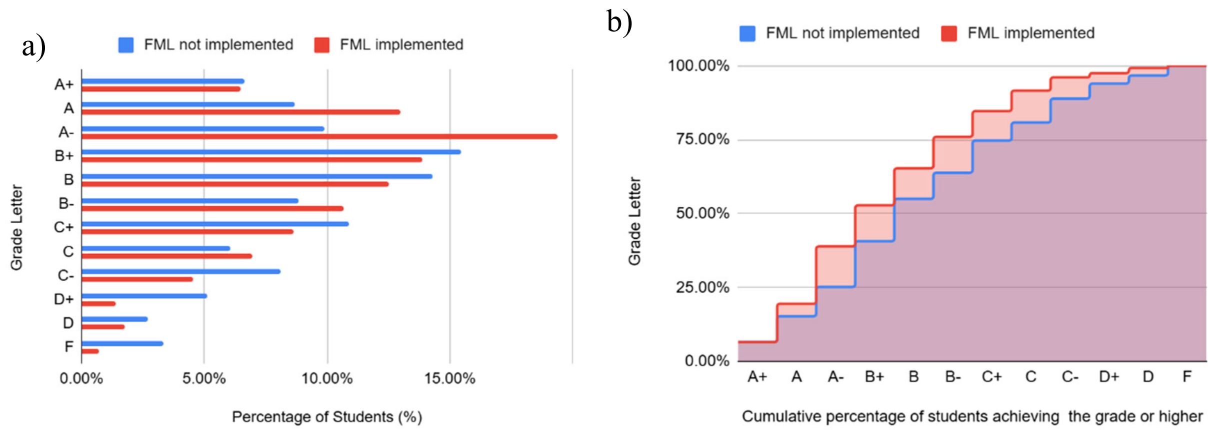

Figure 6. Grade distribution comparison with and without FML. (a) Percentage of students per letter grade. (b) Cumulative percentage of students achieving each grade or higher, highlighting overall performance improvement with FML.

While Figure 5 examines differences in grade outcomes between minimal and moderate-to-comprehensive FML participants, Figure 6 complements these findings by illustrating how FML affects the entire class cohort—including minimally engaged students—before and after implementation. Together, these figures underscore that FML supports improved academic performance not only for highly engaged participants, but also across the broader student population, as evidenced by the shift in mean grades and the higher percentage of students in top grade tiers.

4.4. Survey Feedback

A voluntary feedback survey was administered, capturing a small subset (3.4% of the entire class) of student perspectives on FML. Despite the low response rate, the comments provide valuable insights into FML's motivational impact and overall reception among participants.

4.4.1 Highlights from Survey Results

Many survey respondents highlighted FML's positive effect on engagement and enjoyment. Specifically, 84.9% indicated that class discussions were a standout feature, 59.5% underscored the usefulness of Mentimeter quizzes, and 51.4% appreciated the deliberate mistake-correction exercises. These interactive activities, accompanied by real-time feedback, appear to have contributed meaningfully to students' conceptual clarity and sustained interest. Over half of the participants described the competitive and points-based nature of FML as at least "somewhat motivating," suggesting that the system's gamified structure succeeded in making lectures feel more dynamic and encouraging many students to become active contributors.

4.4.2 Positive Feedback from Email Correspondence

In addition to survey responses, several students emailed individual comments expressing appreciation for the FML approach and the interactive teaching style. Select remarks include:

- "I just wanted to say how much I've enjoyed being part of your class. Since September, I feel like I've learned so much, and the teaching style has made everything easier to understand. It's clear, engaging, and honestly, one of the best I've experienced."
- "The FML sessions really got everyone involved and made those early 8:30 a.m. lectures way more manageable. It was such a great way to keep everyone awake and learning!"
- "Thank you so much for all the efforts put into making the FML possible. Participating in it was enjoyable, and the lectures were always full of enthusiasm."
- "It has been a pleasure attending these lectures. The FML created a fun and interactive atmosphere that is quite different from other courses."
- "Participating in class problems on the tablet in front of everyone helped build confidence and understanding. Although winning the FML was not possible for me, the overall experience was so fun and enjoyable."
- "Taking Engineering Mechanics has been tough at times, but the subject matter was ultimately rewarding. The FML framework made complicated ideas more engaging and digestible."

These statements frequently mention increased motivation, accessibility of course content, and enjoyment due to interactive features and the FML's gamified elements. Students highlight the practicality of real-time engagement, the novelty of competition-driven activities, and the inclusive learning environment. Moreover, several comments point to improvements in confidence and a heightened sense of community—factors that are often challenging to cultivate in large classroom settings.

4.4.3 Summary of Positive Insights

Overall, the survey data and accompanying email feedback underscore four main strengths of FML. First, interactive elements such as class discussions, quizzes, and error-detection tasks generated sustained engagement even in a large-class format. Second, many students reported improved understanding due to the immediacy of feedback and hands-on problem-solving opportunities. Third, the competitive yet friendly environment fueled motivation, especially among those striving for a higher position on the leaderboard. Finally, the gamified approach seemed to create a positive, community-oriented atmosphere, leading many respondents to favourably compare this course with less interactive alternatives in their first-year experience.

4.5. Institutional Course Evaluation Results

To complement the findings from the FML-specific survey, institutional course evaluations (SPOT surveys) were analyzed for semesters before and after FML implementation. These surveys, administered by the university, provide broader student perspectives and had a significantly higher response rate, increasing from 40.3% to 60.7%.

Figure 7 presents comparative results for Course Delivery and Class Climate, two key metrics related to student engagement and classroom experience. Notably, the percentage of students selecting "Strongly Agree" rose from approximately 25% to between 45% and 55% in both categories. When combining "Agree" and "Strongly Agree" responses, overall student approval increased from 75% to 88%, indicating a substantial improvement in students' perceived quality of instruction and classroom environment.

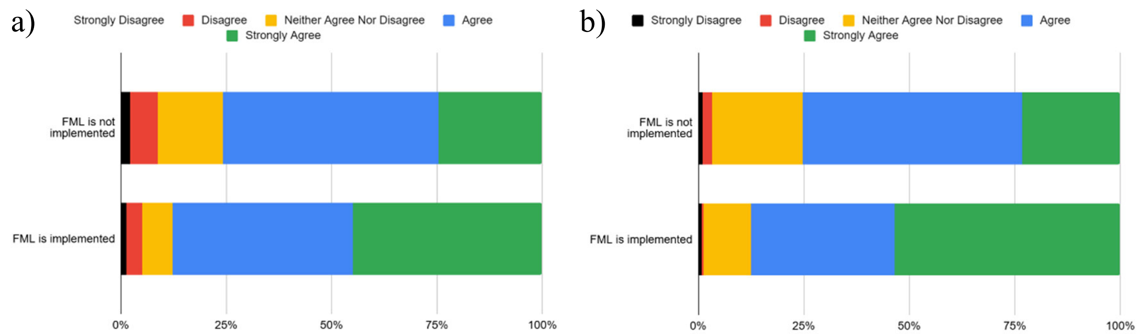

Figure 7. Institutional course evaluation comparison before and after FML implementation. (a) Course Delivery: Increase in student agreement on effective course delivery with FML. (b) Class Climate: Higher student satisfaction with classroom engagement and atmosphere following FML implementation.

These results highlight the positive impact of FML, suggesting that integrating gamified and interactive learning strategies contributed to a more engaging, inclusive, and effective learning experience in large-class settings. The increase in student agreement further supports FML’s role in enhancing student motivation, participation, and overall course satisfaction.

5. Discussion

From the instructor perspective, these findings align with observed improvements in classroom energy and question quality during lectures. Instructors noted that students who rarely participated before FML started asking more frequent and probing questions after gaining confidence in the gamified tasks. While the added logistics of tracking points and guiding volunteers in “Act-as-Professor” occasionally taxed instructional time, most instructors felt the boost in student enthusiasm justified these efforts. They also suggested that more structured instructor training or an assistant dedicated to FML tasks could further improve consistency and address any bottlenecks in large-scale adoption.

The data indicate that gamified, active-learning strategies can significantly boost engagement in large engineering courses. In line with Prince’s review [1], consistent participation in active tasks—whether through immediate feedback quizzes or interactive problem-solving—correlates with improved understanding and performance.

1. **Importance of Varied Activities**

   The wide acceptance of Menti Quizzes (56.7%) emphasizes the appeal of immediate, low-pressure interactions, especially among introverts. Meanwhile, *Correct Mistakes* and *Act-as-Professor*—although smaller in overall proportion—fostered deeper cognitive engagement, teaching students how to detect, analyze, and rectify errors or lead discussions effectively. This is consistent with cooperative and problem-based learning theories, which highlight the value of learning from peers and through realistic problem-solving tasks [10]–[12].

2. **Large-Scale vs. Individual Engagement**

   Large-scale activities (e.g., Menti Quizzes, MecSimCalc) had the highest participation ratios because they were quick to deploy, catered to diverse learning styles, and often offered higher point incentives to "revive hope" among students who fell behind early. Individual engagement, while lower in percentage, remained critical for deeper learning, personal growth, and communication skill development.

3. **Self-Determination and Autonomy**

   FML activities addressed various dimensions of self-determination theory by giving students autonomy (choice of when/how to participate), competence (immediate feedback, levelling up), and relatedness (team-based incentives, peer visibility) [8], [9]. Students in focus groups reported enjoying the sense of community and friendly rivalry, which validated the collaborative and competitive aspects of FML.

4. **Challenges and Future Improvements**

   - *Maintaining Momentum*: After the initial weeks, some students experienced mid-semester fatigue. To sustain enthusiasm without linking participation to grades, introducing non-grade-related incentives, such as gamified challenges, themed weeks, or recognition-based rewards (e.g., badges, leaderboards, or shoutouts), can help re-energize students. Offering monthly prizes for active participation, rather than a single prize at the end of the semester, can also refresh engagement and keep students motivated throughout the course.

   - *Instructor Training*: Activities like "Act-as-Professor" require instructors to be adept at guiding and supporting students publicly, ensuring the experience remains positive rather than stressful. Offering professional development opportunities and creating best-practice guidelines can refine this process and provide instructors with the confidence to manage these activities effectively.

   - *Scalability and Resources*: Building personalized quizzes on MecSimCalc demands time and technical expertise. Investing in user-friendly platforms and teaching assistants trained in such tools can alleviate faculty workload.

   - *Gathering Demographic Insights:* Future iterations of FML could benefit from gathering demographic data, such as students' prior knowledge, learning styles, and background, to better understand which groups derive the most benefit from specific FML activities. These insights can guide the design of more targeted and inclusive engagement strategies.

- *Promoting Cooperative Learning Through Group and Individual Stream:* To foster both collaboration and individual accountability, the FML framework can include two parallel streams: an Individual Stream (similar to the current setup) and a Group Stream. In the Group Stream, students would compete as part of teams, with their points contributing to the group's overall performance. Teams can be formed randomly or based on shared interests to encourage diversity and promote cooperative learning. Both streams would operate independently, with separate prizes to recognize achievements in each. This dual approach allows students to engage in both self-driven and team-oriented activities, providing opportunities to develop leadership, communication, and problem-solving skills while keeping competition balanced and inclusive.

6. Conclusion

This paper's findings indicate that the Fantasy Mechanics League (FML)—a structured, gamified approach—substantially enhances active learning and engagement in large introductory engineering mechanics courses. By integrating multiple strategies (discussions, error-correction tasks, peer-led demonstrations, and digital quizzes), FML cultivates a more inclusive and motivating environment for first-year students. Notably, the approach led to a measurable increase in the number of top-performing students and significantly higher levels of student satisfaction, as evidenced by institutional course evaluations and the overall class mean grade shifting from B+ to A–. Taken together, these results underscore the transformative potential of FML in boosting both participation and academic outcomes in traditionally challenging large-class settings.

While the results of FML are encouraging, there are opportunities to further refine its implementation and broaden its impact. Key areas include managing instructor workload, sustaining long-term engagement, and ensuring that gamification elements support intrinsic motivation. Future work could explore longitudinal impacts, involve larger and more diverse student populations, and compare FML-based instruction to traditional, non-gamified approaches to assess overall effectiveness. Future work could involve more diverse student populations, compare FML with non-gamified instruction, and investigate demographic factors (e.g., gender, race) to foster inclusivity. Finally, dedicating teaching assistants or refining the timing and incentives for FML-related surveys may help sustain momentum, expand participation, and deepen engineering concepts over time.

Overall, FML aligns with active-learning and self-determination frameworks by offering meaningful autonomy, competency-building, and social connection. With adequate resources and careful planning, it can boost student motivation, deepen conceptual mastery, and foster a vibrant learning culture—even in large-class settings—ultimately reshaping how large-scale STEM courses are delivered.

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