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GAMIFICATION AS A PEDAGOGICAL STRATEGY: ENHANCING STUDENT PERFORMANCE, MINDSET, AND METACOGNITION

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ABSTRACT

Gamification transforms traditional learning by integrating game elements into educational settings, fostering an interactive and immersive experience. This study examines the impact of gamification on academic performance, growth mindset, and metacognition among university students. A total of 440 students participated in an empirical study employing a pre-test post-test control group design. The sampling method was purposive, and the study was conducted as a field experiment with four distinct groups: (1) Gamification Group (learning with game-based interventions), (2) Interactive Curriculum Group (engagement-driven curriculum without game elements), (3) Performance-Based Reward Group (traditional learning supplemented with performance incentives), and (4) Control Group (conventional teaching methods). The findings indicate a statistically significant improvement in performance, growth mindset, and metacognition among students in the Gamification Group compared to the Control Group ($p < 0.05$). Further, a significant mean difference was observed between the Gamification Group and the Interactive Curriculum Group, as well as between the Performance-Based Reward Group and the Control Group ($p < 0.05$). However, neither intrinsic nor autonomous motivation mediated or moderated the relationships between gamification and the study variables. These findings underscore the potential of gamification as an effective pedagogical tool for enhancing student engagement, learning outcomes, and cognitive development when integrated with the course curriculum.

Keywords: gamification, growth mindset, academic performance, metacognition, self-determination theory, intrinsic motivation, autonomous motivation, interactive curriculum, performance-based reward system, conventional teaching.

1. INTRODUCTION

Games and play are often used interchangeably as activities with a specific goal, structured within defined rules, and fostering an immersive experience. While play is generally unstructured and primarily for fun, games have predetermined objectives. Games engage players deeply, leading to emotional immersion, enjoyment, and a sense of achievement. Serious games are designed not only for entertainment but also to achieve specific learning outcomes. Learning through play is widely acknowledged in psychology and education. Humans and animals engage in play as a natural learning mechanism. Even newborns begin learning through exploration and interaction. However, traditional learning processes are often not perceived as enjoyable. Engaging students in educational activities remains a challenge, prompting significant investments in educational technology and gaming strategies.

Education has shifted from a teacher-centric approach to a student-driven, open-learning environment. With digital resources, high-quality materials are accessible, but intrinsic motivation to engage with these materials is inconsistent. For students to commit to learning, they must be intrinsically motivated—similar to their engagement in gaming. The challenge is to create a learning environment that fosters emotional engagement and motivation, achievable through integrating gaming elements into education. Gamification has emerged as an innovative approach. Coined by Nick Pelling in 2002, the term gained widespread recognition in 2010. It is commonly defined as the use of game design elements in non-game contexts. Some scholars describe it as the application of game mechanics and

strategies to solve real-world problems. Others argue that games extend beyond entertainment and can be applied to real-life problem-solving. The application of game-based mechanics in education has led to the development of game-based learning methodologies. Gamification in education involves using game mechanics to enhance instruction and student engagement. The appeal of games lies in their ability to generate curiosity, novelty, and a sense of progression—an aspect educators aim to replicate in the learning environment. Thus, gamification presents an opportunity for institutions to improve student engagement and learning outcomes.

Game-based pedagogy applies gaming principles to restructure learning environments to cater to modern learners' needs. It draws from motivation and social learning theories, emphasizing collaboration, competition, and belonging. Self-Determination Theory suggests that individuals are intrinsically motivated when they feel competent, autonomous, and connected. A well-structured gamified learning environment includes autonomy, belongingness, and competence. Autonomy allows students to make choices, mirroring game dynamics where players select avatars, levels, or challenges. In academics, this can translate into choosing projects, deadlines, or leaderboard participation. Belongingness fosters collaboration and healthy competition, similar to how students build connections in a gamified classroom. Competence is achieved by maintaining an optimal level of challenge—neither too easy nor too difficult. A well-designed gamified curriculum offers students meaningful challenges that match their skill levels.

Researchers have identified several key components of gamification that contribute to its effectiveness. Five essential elements of game dynamics include constraints, emotions, narrative, progress indicators, and relationships. Constraints define limitations within the learning environment, ensuring structured exploration. Emotions create an emotional connection between students and their learning tasks, increasing motivation. Narrative structures craft an engaging and immersive learning experience, making abstract concepts tangible. Progress indicators, such as progress bars and leaderboards, provide instant feedback and help students monitor their advancement. Relationships within a gamified learning environment build connections between students, instructors, and content, fostering a sense of community and collaboration.

Game mechanics, such as challenges, competition, cooperation, feedback, rewards, and goal-setting, further enhance engagement. Common gamification components include levels, badges, points, avatars, quests, leaderboards, and virtual rewards. To implement gamification effectively, educators should set clear learning objectives, design structured assessments with defined targets, empower students with meaningful choices, integrate immersive activities, and ensure a balance of fun and learning. These principles guide the implementation of gamified learning environments that cater to diverse learners and enhance motivation.

Academic performance is typically assessed through formative evaluations, such as class tests, and summative evaluations, such as semester exams. Performance is influenced by multiple factors, including prior knowledge, learning habits, available resources, and instructional quality. Gamification can enhance academic performance by increasing engagement, fostering intrinsic motivation, and making learning interactive. By incorporating game elements such as progress tracking, competition, and rewards, gamified learning environments encourage students to take an active role in their education, leading to improved retention and understanding of course material.

A mindset is a set of beliefs influencing how individuals approach learning and challenges. Researchers emphasize that behavior is shaped by implicit theories regarding intelligence. A growth mindset is the belief that abilities can be developed through effort and

persistence. Students with a growth mindset embrace challenges, exert effort, and view failures as learning opportunities. Conversely, a fixed mindset assumes intelligence is static, leading to avoidance of challenges and fear of failure. Students with a fixed mindset are less likely to exert effort or recover from setbacks. Fostering a growth mindset through gamification encourages students to persist, engage with challenges, and develop resilience. By incorporating elements reinforcing effort, progress, and improvement, gamification helps students develop a more positive learning approach.

Metacognition refers to the ability to understand, analyze, and regulate one's thinking processes. It involves knowledge of cognition, which includes understanding what, how, and when to apply learned concepts, and regulation of cognition, which includes setting learning goals, using effective strategies, and self-evaluating progress. Metacognition is crucial for student success, as it enables learners to monitor their progress, reflect on their learning, and apply strategies for improvement. Gamification can enhance metacognitive abilities by promoting self-assessment, goal-setting, and strategic thinking. By integrating reflection prompts, feedback loops, and goal-oriented tasks, gamified learning environments encourage students to think critically about their learning processes and make adjustments accordingly.

Gamification offers an innovative and interactive approach to education by incorporating game elements to enhance motivation and engagement. However, its implementation has yielded mixed results. This study aims to provide empirical evidence on the impact of gamification on students' performance, mindset, and metacognition. By integrating game-based principles within an undergraduate learning environment, this research explores how gamification influences student motivation, self-regulation, and academic achievement. Guided by Self-Determination Theory, the study investigates the effectiveness of gamification in fostering engagement, mastery, and cognitive growth—key attributes of 21st-century education. Although gamification holds promise for transforming education, challenges remain in designing coherent and efficient frameworks. This research seeks to contribute to developing structured gamification strategies that can be effectively integrated into diverse educational settings. By examining gamification in education, this study informs educators, policymakers, and researchers on best practices for implementing game-based learning techniques to enhance student outcomes.

2. REVIEW OF LITERATURE

Conducting a literature review allows researchers to critically assess existing knowledge, identifying strengths and weaknesses in prior studies. This process aids in refining research approaches, mitigating potential weaknesses, and leveraging established strengths. An extensive literature review contextualizes the study within the broader academic discourse. The sources consulted for this review included libraries at Anna University Chennai and Madras University Chennai, as well as the British Council Library, Chennai. Online databases such as Google Scholar, Microsoft Academic, ResearchGate, World Wide Science, and PubMed Central were frequently accessed. Requests for research papers were sent to various authors, prioritizing Scopus-indexed works. References were also drawn from Springer Journals.

The increasing adoption of unconventional teaching methodologies has garnered global attention for sustaining learner engagement and improving knowledge application (Topal & Sezen-Gultekin, 2020; Merino de Paz, 2013; Neeli, 2012). Gamification has emerged as a leading pedagogical approach due to its ability to apply gaming principles in non-gaming educational settings (Fitz-Walter, Tjondronegoro, & Wyeth, 2012). Its integration into education facilitates instant feedback, fostering deeper learning and reinforcing learning

objectives (Kapp, 2012). Research further highlights that gamification enhances student motivation and engagement (Simões et al., 2012).

Gamification employs game mechanics such as challenges, rewards, feedback, badges, levels, and leaderboards to create an interactive learning environment (Sarbadhikari & Sood, 2018; Kapp, 2016; Nah et al., 2014). Herzig et al. (2015) emphasized gamification's potential as a psychological and instructional design approach that customizes learning experiences. Miller (2013) advocated for engaging tools over traditional lectures, highlighting simulation-based learning to promote teamwork, debates, and discussions. Rahn (2014) underscored the importance of goal-setting, challenging assignments, and storytelling in improving learning outcomes.

A key distinction exists between game-based learning and gamification (Caponetto, Earp, & Ott, 2014). While game-based learning integrates actual games into education, gamification incorporates game dynamics and mechanics in non-gaming contexts to boost engagement and learning outcomes (Wiggins, 2016). Research supports gamification's effectiveness in improving motivation, fostering active participation, and empowering educators to create engaging learning environments (Lee, 2011).

Several studies have examined gamification's effectiveness. Hamari, Koivisto, and Sarsa (2014) conducted a comprehensive literature review emphasizing the importance of user profiles and contextual factors in gamification success. Da Rocha Seixas, Gomes, and de Melo Filho (2016) explored gamification's impact on student engagement, concluding that reward systems, such as badges, enhance learning motivation. Su (2016) studied the relationship between cognitive load, motivation, and learning anxiety, demonstrating gamification's positive influence on academic performance. Landers and Callan (2011) explored social networking as a gamified learning tool, suggesting that gamification fosters motivation when aligned with pedagogy.

Further studies highlight gamification's benefits in structuring assessment systems, promoting competitive and collaborative learning, and improving academic performance (De-Marcos et al., 2014; Aguilar, Holman, & Fishman, 2018). Researchers have also noted that gamified platforms using leaderboards and progress tracking enhance student motivation and academic achievement (Simões, Redondo, & Vilas, 2013; Richter, Raban, & Rafaeli, 2015).

Gamification involves various game elements that influence student motivation and learning outcomes. Bovermann and Bastiaens (2019) investigated the role of points and leaderboards in fostering collaborative learning and intrinsic motivation. Kotsopoulos et al. (2020) emphasized the impact of rewards, self-regulation, and personalized feedback on engagement. Chandra et al. (2019) highlighted gamification's role in soft skills development, using e-badges as incentives. Hamari (2017) conducted a field experiment demonstrating the positive effects of badges on student engagement, while Korkeila and Hamari (2020) examined the association between digital avatars and student identity.

Motivation plays a crucial role in gamification. Buckley and Doyle (2016) explored intrinsic and extrinsic motivation in gamified settings, concluding that engagement levels vary based on motivational drivers. Bergmann and Sams (2012) emphasized the importance of personalized learning environments incorporating intrinsic reward systems to sustain motivation. Hamari and Koivisto (2015) examined social influences on gamification, highlighting that social approval and peer recognition significantly impact student participation and performance.

Self-Determination Theory (Deci & Ryan, 2004) is widely applied in gamification research, explaining how autonomy, competence, and relatedness contribute to motivation. Gamification fosters motivation by integrating freedom to fail, self-monitoring, and personalized feedback mechanisms (Peng et al., 2012). Studies suggest that students are more

engaged when they experience autonomy and competence in their learning processes (Reeve et al., 2004).

Dweck et al. (1973, 1978, 2013) introduced the concept of growth mindset, which posits that students who believe intelligence is malleable demonstrate higher resilience and motivation. Research supports that students with a growth mindset persist in challenging tasks and exhibit enhanced academic performance (Duckworth, 2016; Yeager et al., 2016). Studies have also explored the impact of gamification on fostering a growth mindset, emphasizing the role of rewards, challenges, and feedback in shaping student attitudes (Rhew et al., 2018; O'Rourke et al., 2016).

Metacognition, or self-awareness in learning, is crucial for fostering critical thinking and adaptive intelligence (Hooks, 2010; Winne, 2017). Research suggests that gamified learning environments enhance metacognitive skills by encouraging self-reflection and goal-directed thinking (Tang & Kay, 2014; Al-Hilawani, 2016). Studies have also linked metacognition to improved problem-solving abilities and decision-making (Moshman, 2018; Escorcia & Ros, 2019).

Indian researchers have explored gamification's relevance in educational contexts. Mishra (2019) and Jain & Dutta (2019) advocated for adaptive and time-based gamification models to enhance student engagement. Jose & Vinay (2017) demonstrated the effectiveness of gamified classrooms, reporting significant performance improvements. Bhattacharyya, Jena, and Pradhan (2018) emphasized gamification's potential in fostering meaningful student engagement.

Despite its benefits, gamification has limitations. Hanus and Fox (2015) found that prolonged gamification could decrease intrinsic motivation. Researchers caution against over-reliance on reward-based mechanics, which may overshadow learning objectives (Deci, Koestner, & Ryan, 2001). Other studies highlight challenges such as increased teacher workload, reduced playfulness, and the potential loss of educational focus (Lee, 2011; Holman, Fishman, & Aguilar, 2013).

Although gamification has shown promise, empirical research on its effectiveness in Indian undergraduate education remains limited. This study seeks to bridge this gap by investigating the impact of gamification on student performance, mindset, and metacognition. By employing a simplified game framework, this research aims to balance gamification's benefits with pedagogical integrity. Integrating gamification with motivational theories and self-regulated learning strategies, this study seeks to offer insights into its effective implementation in higher education.

3. RESEARCH PROBLEM, OBJECTIVES & HYPOTHESES

3.1. Research Problem

The present study seeks to enhance the general understanding of gamification by elucidating how and why it functions as an effective pedagogical tool. To achieve this, an empirical approach is adopted to investigate the underlying concepts of gamification and its effectiveness in an educational setting. The core research problem focuses on assessing the impact of gamification as an intervention on students' academic performance, growth mindset, and metacognition.

The study aims to address the following research questions:

Primary Research Question:

- Does gamification as a pedagogical tool influence academic performance, growth mindset, and metacognition of students?

Sub-Questions:

- How does an interactive curriculum impact academic performance, growth mindset, and metacognition of students?
- What effect does a performance-based rewards system have on academic performance, growth mindset, and metacognition?
- What is the relationship between growth mindset, metacognition, and academic performance?
- How does the interaction between growth mindset and metacognition influence academic performance?
- Does autonomous motivation moderate the relationship between gamification and academic performance?
- What is the mediating role of interest, perceived competence, effort, tension, and perceived choice in relation to growth mindset?
- What is the end-user value of gamification in higher education?

3.2. Research Objectives

Research objectives define the expected outcomes of this study, guiding the investigation into how gamification enhances student engagement and learning. This study aims to redesign the learning environment for university students through gamification to increase interest and reduce the perceived monotony of conventional education.

The specific objectives are:

- To assess the impact of gamification on academic performance, growth mindset, and metacognition.
- To examine how an interactive curriculum influences these three aspects of student learning.
- To evaluate the effects of a performance-based rewards system on academic performance, growth mindset, and metacognition.
- To investigate the relationship between growth mindset, metacognition, and academic performance.
- To analyze the impact of the interaction between growth mindset and metacognition on academic performance.
- To determine whether autonomous motivation moderates the relationship between gamification and academic performance.
- To explore the mediating role of interest, perceived competence, effort, tension, and perceived choice on growth mindset.
- To assess the overall value of gamification as an instructional strategy in higher education.

3.3. Hypotheses

This study tests the following null hypotheses:

- Gamification does not significantly impact academic performance, growth mindset, or metacognition.
- An interactive curriculum (without gamification elements) has no significant effect on these three learning dimensions.
- A performance-based rewards system does not significantly influence academic performance, growth mindset, or metacognition.
- There is no significant relationship between growth mindset, metacognition, and academic performance.
- The interaction between growth mindset and metacognition does not significantly affect academic performance.

- Autonomous motivation does not moderate the relationship between gamification and academic performance.
- Interest, perceived competence, effort, tension, and perceived choice do not significantly mediate the relationship between gamification and growth mindset.
- Gamification does not provide significant value as a pedagogical tool in higher education.
- Through empirical analysis, this study aims to validate or refute these hypotheses, contributing to a better understanding of gamification's effectiveness in higher education.

4. RESEARCH METHOD

A crucial aspect of research is the use of appropriate methods. Research involves a systematic, precise, efficient, and credible exploration of the unknown, explanation of unexplored phenomena, and establishment of relationships and causations that enable factual predictions under specific conditions. It also includes identifying gaps in knowledge, validating existing findings, and recognizing previous limitations and oversights. The strength of research findings largely depends on the methodology employed.

4.1. Research Design

A research design serves as a blueprint or a comprehensive framework for the study. It details various processes involved, such as defining operational variables, selecting the sampling design and size, determining methods of data collection, and specifying the instruments used for data gathering. This study follows an empirical research approach and employs quasi-experimental research methods to collect and analyze data using computational techniques.

4.1.1. Quasi-Experimental Research

In the fields of Psychology and Education, conducting pure experimental research—where subjects are randomly assigned to experimental or control groups—is often challenging due to design limitations. When random allocation is not feasible, quasi-experimental designs are used. Since classroom groups are pre-determined, and controlling extraneous variables such as intelligence and personality traits is difficult, this study adopts a quasi-experimental design. Specifically, it follows a **pre-test post-test control four-group design** to assess the impact of the independent variable.

4.1.2. Procedure

All groups underwent a pre-test on the dependent variable. The experimental groups then received the treatment (independent variable), while the control groups did not. After the intervention, all groups were post-tested on the dependent variable. While the groups were randomly assigned to either the experimental or control condition, individual subjects could not be randomly assigned to these groups due to the nature of the classroom setting.

Table4.1:CharttorepresenttheDesignoftheStudy

Assignmentof Subjects to:	O1= (Pre-test) Of dependentvariable	Exposure to Treatment(X) independent variable	O2= (Post-test) of dependentvariable
Treatment Group 1	Treatmentgroup1's average score on dependent variable	X1 (Gamification)	Treatmentgroup1's average score on dependent variable

Treatment Group 2	Treatmentgroup2's average score on dependent variable	X2(Interactive Curriculum)	Treatmentgroup2's average score on dependent variable
Treatment Group 3	Treatmentgroup3's average score on dependent variable	X3(Performance based Reward System)	Treatmentgroup3's average score on dependent variable
Control Group	Control group's average score on dependentvariable		Control group's average score on dependentvariable

Treatment and Control Groups

- Treatment Group 1: N O_1 X_1 O_2
- Treatment Group 2: N O_1 X_2 O_2
- Treatment Group 3: N O_1 X_3 O_2
- Control Group: N O_1 – O_2

This study follows a non-randomized, pre-test/post-test control group design, where:

- X represents different treatments applied to X_1, X_2, and X_3.
- O_1 denotes the pre-test observation on the dependent variable.
- O_2 denotes the post-test observation on the dependent variable.

Pre-test / Post-test: Within Group Differences

- Control Group Difference: *Control group pre-test score – Control group post-test score* = Change in the dependent variable without exposure to the independent (treatment) variable.
- Experimental Group Difference: *Experimental group pre-test score – Experimental group post-test score* = Change in the dependent variable with exposure to the independent (treatment) variable.

The difference observed in the control group's scores from pre-test to post-test represents the natural change expected in the dependent variable without intervention. In contrast, the difference observed in the experimental group's scores from pre-test to post-test represents the effect of the independent variable.

Limitations of the Design

One limitation of this design is the potential lack of control over the gains observed in the post-test. The testing effect—where participants' familiarity with the test format due to the pre-test experience—may influence their performance and reduce the internal validity of the experiment.

4.1.3. Gamification as a Pedagogical Intervention

a. Development of the Model

A course titled **"Stress Management for Personal and Professional Development"** was gamified for the purpose of this research. It was a three-credit course conducted during an even semester over a period of six months. Classes were held for approximately 15–16 weeks, followed by an end-semester summative examination.

Course Objectives:

- To develop a deep understanding of the causes, symptoms, and impact of stress in daily life.
- To enhance knowledge of basic emotions and differentiate between negative and

positive emotions.

- To understand the relationship between stress and performance.
- To emphasize the importance of subjective well-being, optimism, resilience, hope, and happiness in personal and professional development.
- To learn various stress management techniques.

Pedagogical Approaches Used:

- Blended Learning
- Interactive Activities
- Psychometric Assessments (Self-Rated Questionnaires for Personal Insights)
- Group Discussions
- Role Plays
- Situation Analyses
- Quizzes, etc.

b. Field Work

Introducing Gamification to Students

Gamification is an emerging and engaging approach to modifying the learning environment. It integrates fun elements from games, allowing learners autonomy in selecting activities and assignments. Similar to a game, students must complete Level 1 before progressing to Level 2. While the levels follow a hierarchical structure, students have the freedom to choose among available options to score points.

Generally, individuals feel more in control when they are given meaningful choices. At the same time, the tasks must be sufficiently challenging to provide intellectual stimulation. A compelling narrative that resonates with learners makes the experience more engaging and rewarding. (Class Instruction)

c. The Game

In this game, every student will start with a base score of 0 XP (Experience Points). As you progress through different levels, you will gain mastery and earn badges. Just like in a game, failure is allowed—you will have opportunities to improve your score by resubmitting assignments.

Additionally, group projects will require strategic thinking, teamwork, cooperation, and collaboration. Bi-weekly challenges will take the form of Boss Battles, where students will need to apply their learning to tackle complex problems.(Class Instruction)

Figure4.1:AddingFuntoKnowledge&SkillDevelopment–MainPurpose of Gamification

d. Infrastructureused–Edmodo(thelearningmanagementsystem)

Edmodo as an Educational Technological Tool

Edmodo (www.edmodo.com) is an educational technology platform that provides a

free learning management system (LMS) designed to facilitate interaction between teachers and students. It enables the sharing of classroom instructions, assignments, and exams. The platform allows instructors to set deadlines for assignments, provide feedback, and collect student responses through polls.

Class Instruction:

In this class, we will be using an interactive learning management system called **Edmodo**.

Edmodo is user-friendly and free to access. You can join the class using a link that will be shared with you. Some of your class assignments will be distributed via Edmodo.Through the Edmodo network, you will be able to interact with your teacher and classmates. The platform supports the sharing of course content, including notes, assignments, and quizzes. Your responses will be directly evaluated, allowing you to receive faster feedback on your work."*

Figure4.2:Instructor'sPageinEdmodo

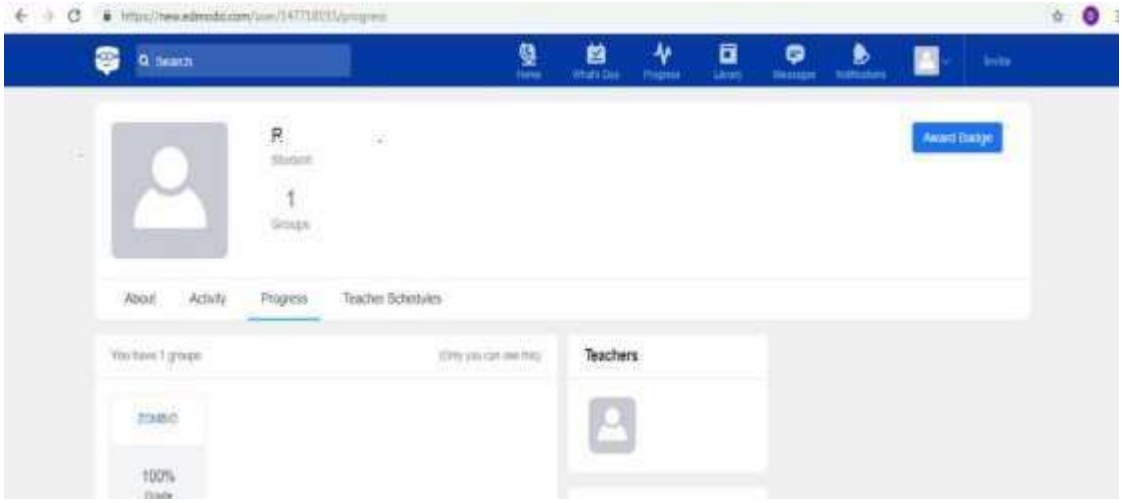

Figure4.3:Student'sProfileinEdmodo

e. Developing the Narrative of the Game 'Zombio'

Stress is much like a zombie—it lacks positivity, acts without purpose or logical

reasoning, and ignores all the goodness around us. It attacks without warning, consumes our thoughts, and drains our energy.

Figure4.4:Theprocessofachievingavibrantlife

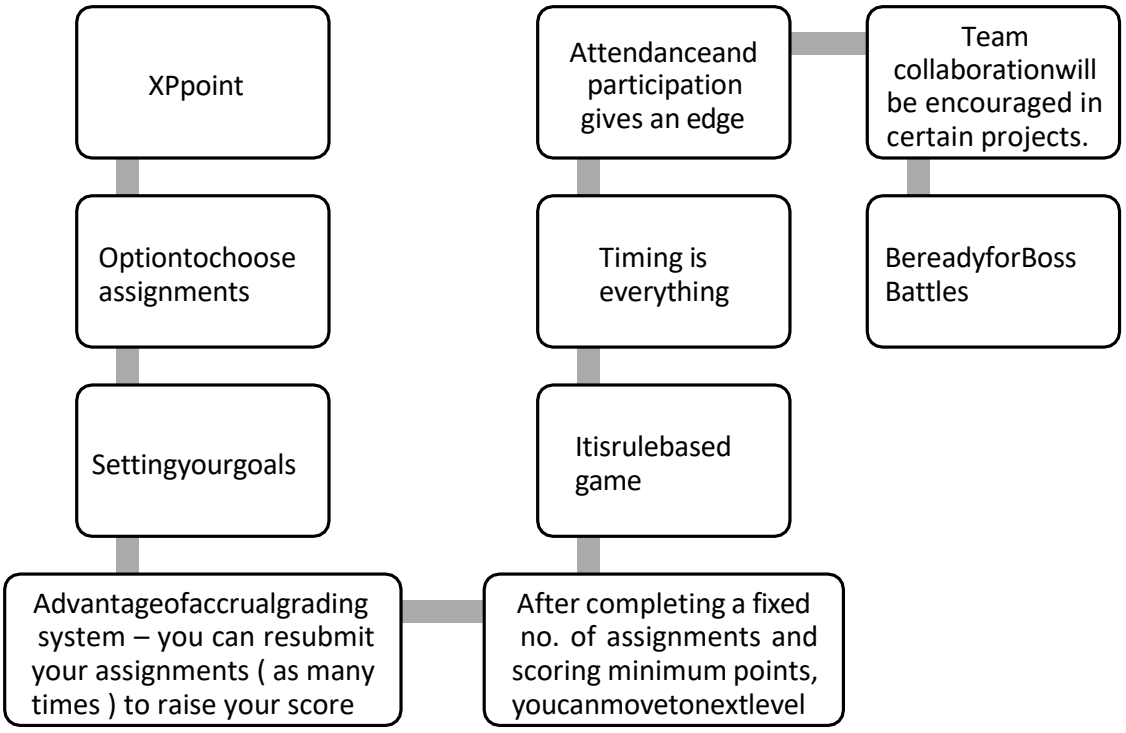

Figure4.5:XPPointsbasedGradingSystem

f. Class Activities Assigned During the Study

Individual Activities:

- Journals/diary writing
- Action plan to overcome fear
- Thought reconstruction activity
- Blogging
- Scenario-based problem-solving
- Time management matrix
- Mind mapping on stress management
- Value clarification and commitment
- Personality profiling
- SMART goal setting and career planning

Group Activities:

- Role plays/skits
- Project on the Happiness Meter
- The Hobby Section activity
- Johari Window exercise

- Case study discussions
- Boss Battles
- Debates on ethical dilemmas
- Written assignment: Team reflection summary on the importance of stress management workshops in corporate settings

g. Introducing Quizlet (www.quizlet.com)

- Quizlet is an interactive study tool accessible via both web and mobile platforms.
- It utilizes flashcards to present information on a given topic, followed by quiz options.
- Upon submitting answers, users receive instant feedback on their performance.
- If a user does not achieve a satisfactory score, they can retake the quiz multiple times. There are no limits on test attempts.

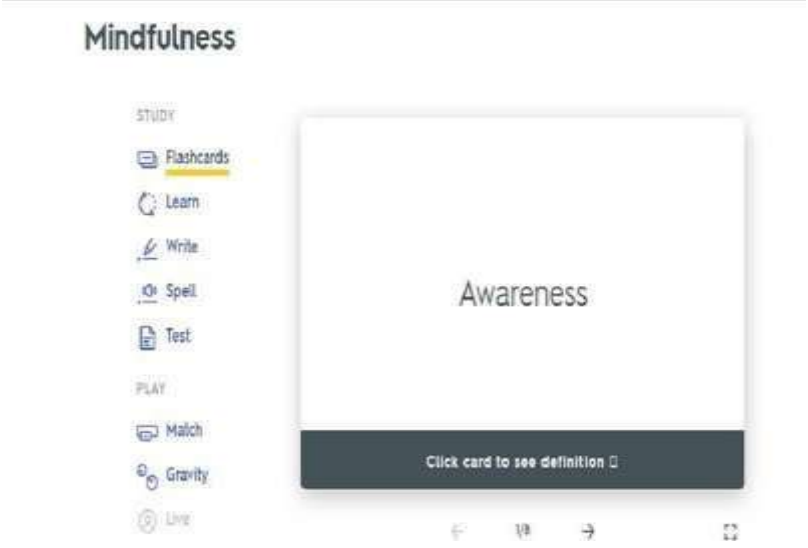

Figure 4.6:Example ofa Quizlet Flashcard

h. Rules of the Game

- The semester consists of approximately 30 classes.
- Activities in Level 1 will be available starting from the second class.
- You must register or log in to Edmodo to participate in the game.
- Once registered, your levels will be unlocked progressively.
- To advance to the next level, you must complete all activities and assignments in the current level. For example, Level 1 activities must be submitted to unlock Level 2.
- The Mid-Semester Exam (Level 3) will unlock automatically on the scheduled date, regardless of your progress in previous levels.
- You have the freedom to choose between different assignments.
- You can resubmit assignments (within set limits) to improve your score.
- The assessment rubrics will provide guidance on how to enhance your performance and achieve a higher score.
- Weeklybadgessummaryand leaderboard withheraldry willbe shown.
- Therecan be many winners.
- Studentcantakepriorappointment withthefacultyforindividual feedback.
- Allsubmissionsaretimebound,afterwhichtheywillnotbe accepted.
- Teamwork is encouraged. There are many group activities included in the

assignments.

- Healthy competition is encouraged. Students must develop collaborative strategies to stay ahead in the game.
- Bossbattlesarethespecialelementsintroducedinthegame.Hereyoucanthrow a difficult or challenging question to other team members. If they answer they will get the points and if they fail to do so the points are given to you.
- PriorinformationmustbegiventotheteambeforetheyarechallengedforaBoss Battle.
- Class participation, discipline and supportive behaviour towards peers will be awarded with badges.

Figure4.7:BadgesandWinner's Throne

5. RESULTS AND DISCUSSION

Data analysis involves systematically examining data using statistical and logical techniques to interpret, express, and illustrate information in a comprehensible and explicit manner. The key objective is to summarize results unambiguously so that inferences can be drawn and reproduced in future studies. It provides a foundation for problem-solving, logical reasoning, and decision-making across various fields, including education, business, and health (Xia & Gong, 2014; O'Neil & Schutt, 2013).

This section presents an analysis of data, its interpretation, and summarization. The results are discussed in relation to existing literature to derive future inferences and generalizations. Statistical analysis was performed using the Statistical Package for Social Science (SPSS.25) and Process v.3.3 by Hayes (2018). This section also presents detailed results corresponding to the objectives and hypotheses formulated earlier.

5.1. Objective 1: Impact of Gamification on Academic Performance, Growth Mindset, and Metacognition

Descriptive Statistics for Treatment Group 1

Table 5.1.1 presents the mean, standard deviation, range, maximum, and minimum scores, along with the mean difference between post-test and pre-test scores and percentage change before and after gamification as an intervention.

Table 5.1.1: Descriptive statistics of Treatment Group 1 before and after intervention of Gamification

Variables	N	Maximum Score	Minimum Score	Range	Mean (Pre-test)	Mean (Post-test)	S.D. (Pre-test)	S.D. (Post-test)
Academic Performance	110	12.23	14	7.31	9.22	10.38	2.64	3.17
Growth Mindset	110	4.67	5.35	2.79	3.77	4.46	0.67	0.70
Metacognition	110	8.66	8.95	3.40	5.10	5.72	1.62	1.64

The results indicate that the most significant improvement was observed in growth mindset, with an 18.30% increase, suggesting that gamification fosters a greater sense of competency in students. Academic performance improved by 12.58%, and metacognition increased by 12.16%.

The increase in the standard deviation (S.D.) of post-test scores suggests greater variability in performance, indicating potential improvements in particular domains. As per Garett (2004), standard deviation is a stable measure of variability in experimental research.

5.2. Objective 2: Impact of Interactive Curriculum on Academic Performance, Growth Mindset, and Metacognition

Descriptive Statistics for Treatment Group 2

Table 5.2.1 presents the pre-test and post-test means, standard deviations, and percentage changes for Treatment Group 2 (interactive curriculum without game elements).

Table 5.2.1: Descriptive statistics of Treatment Group 2 before and after intervention

Variables	N	Maximum Score	Minimum Score	Range	Mean (Pre-test)	Mean (Post-test)	S.D. (Pre-test)	S.D. (Post-test)
Academic Performance	110	12.14	13.75	7.47	9.22	9.92	2.55	3.33
Growth Mindset	110	4.72	4.86	2.79	3.80	3.98	0.69	0.68
Metacognition	110	7.70	7.55	3.20	4.72	4.72	1.37	1.42

The highest improvement was in academic performance (7.8%), suggesting that interactive curriculum enhances student engagement but does not significantly impact metacognition or growth mindset.

5.3. Objective 3: Impact of Performance-Based Reward System on Academic Performance, Growth Mindset, and Metacognition

Descriptive Statistics for Treatment Group 3

Table 5.3.1: Descriptive statistics of Treatment Group 3 before and after intervention

Variables	N	Maximum Score	Minimum Score	Range	Mean (Pre-test)	Mean (Post-test)	S.D. (Pre-test)	S.D. (Post-test)
Academic Performance	110	11.73	11.87	6.92	8.94	9.23	1.44	1.33
Growth Mindset	110	5.04	5.12	2.97	4.14	4.32	0.28	0.25
Metacognition	110	8.04	8.20	3.29	5.06	5.02	0.52	0.53

The findings suggest that a performance-based reward system primarily impacts growth mindset (4.35% increase), but does not significantly improve academic performance or metacognition.

5.4. Objective 4: Correlation Among Growth Mindset, Metacognition, and Academic Performance

Table 5.4.1: Correlations matrix among study variables

Variables	Mindset	Metacognition	Performance
Mindset	1	0.586**	0.251
Metacognition	0.586**	1	0.276
Performance	0.251	0.276	1

Growth mindset and metacognition show a significant moderate positive correlation ($r = 0.586$, $p < 0.01$), whereas academic performance does not correlate significantly with either variable.

Gamification significantly enhances academic performance, growth mindset, and metacognition, outperforming interactive curriculum and performance-based reward systems. The findings support gamification as an effective pedagogical strategy, aligning with prior research (Chandra et al., 2019; Kapp, 2016).

Objective 5: To Study the Impact of the Interaction Between Growth Mindset and Metacognition on the Academic Performance of Students

As per Table 5.5.1, the findings are:

- **Beta Value (mindset)** = 0.343, **t (mindset)** = 0.231 (p=0.82)
- **Beta Value (metacognition)** = 0.322, **t (metacognition)** = 0.426 (p=0.68)
- **F = 0.399 (p=0.682)**

The total effect of groups on performance reveals that only **Treatment Group 3** has a significant negative effect on academic performance (**Effect = -1.3467, t= -3.26 & p =0.01**). This confirms the finding that rewards alone cannot support academic performance. The indirect effect of growth mindset and metacognition on performance is not significant. Additionally, there is no interaction effect of growth mindset and metacognition (ModXY) on academic performance (**F=2.142, p=0.174**).

Table 5.5.1: Summary of Interaction of Mindset and Metacognition on Performance

Variables	**F**	**β Value**	**t**	**Significance**
Mindset, Metacognition	0.399	-	-	0.68
Mindset	-	0.107	0.231	0.82
Metacognition	-	0.198	0.426	0.68
Mod (Mindset * Metacognition)	2.14	0.42	1.46	0.17

The interaction between growth mindset and metacognition does not significantly affect academic performance. Since **p > 0.05**, the null hypothesis is accepted, indicating no significant evidence to conclude that the slope of the population regression line is not zero.

Thus, the interaction between metacognition and growth mindset cannot be considered predictors for increasing academic performance.

The data suggests that the interaction of growth mindset and metacognition as a moderator does not affect academic performance. Additionally, the indirect effect of different interventions among groups on academic performance is not significant. However, Treatment Group 3 shows a significant negative effect on performance. This suggests that a

performance-based reward system negatively affects academic performance compared to other groups (Hanus & Fox, 2015; Deci, Koestner & Ryan, 2001).

Objective 6: To Study the Effect of Autonomous Motivation as a Moderator Between Gamification and Academic Performance

The Index of Autonomous Functioning (IAF) measures 'authorship,' 'interest-taking,' and 'low susceptibility to control' based on personality traits (Deci & Ryan, 2012). This study observed a significant effect of conventional teaching methods on growth mindset but not on metacognition and academic performance. This raises pertinent questions, such as whether instructional innovation is the sole factor influencing student performance or if other aspects also play a role. Research indicates that environmental perceptions influence individual efficacy levels, which in turn affects performance (Gist & Mitchell, 1992).

Moderation Analysis of Autonomous Motivation on Academic Performance of Students

Table 5.6.1: Regression model

Variable	R	R2	F	p
Academic Performance	.94	.88	4.19	.09

Table 5.6.2: Moderation Effect of Autonomous Motivation

Moderator Variables	Coefficient	t	LLCI	ULCI
Treatment Group1	-.4	-.15	-7.62	6.82
Treatment Group2	-5.43	-1.74	-14.12	3.26
Treatment Group3	-5.09	-2.04	-12.04	1.85
Autonomous Motivation	-.21	-1.84	-.54	.11
Interaction1	-.002	.015	-.40	.40
Interaction2	.26	1.47	-.23	.74
Interaction3	.21	1.56	-.17	.59

Product terms key:

Interaction1: Treatment Group1 Autonomous Motivation Interaction2: Treatment Group2Autonomous Motivation Interaction3: Treatment Group3 Autonomous Motivation

There is no significant impact of autonomous motivation as a moderator upon academic performance ($F = 0.152$, $p = 0.9886$), as per Table 5.6.1. Therefore, the null hypothesis is accepted, and the alternative hypothesis is rejected. Table 5.6.2 also indicates that there is no interaction effect of autonomous motivation with different groups as an existing dispositional attribute affecting academic performance (Su & Cheng, 2015).

Contrary to the findings of Hamari & Koivisto (2015) and Buckley & Doyle (2016), who suggested a significant role of motivation and social influence, the current study indicates a higher probability of the learning environment impacting academic performance.

Objective 7: To Study the Mediating Role of Interest, Perceived Competence, Effort, Tension, and Perceived Choice on Growth Mindset

Interest has a significant mediating impact on growth mindset ($F = 4.54$, $p = 0.02$), whereas perceived competence, effort, tension, and perceived choice do not significantly

affect growth mindset. The total effect of groups on growth mindset is significant at the 0.00 level, F = 48.44, and the direct effect is also significant at the 0.00 level, F = 39.63.

Thus, there is neither an indirect nor partial mediating effect of interest on growth mindset. The difference in effect may be due to randomized allocation of intervention to groups and personal factors related to the history of students in the control group (Buckley & Doyle, 2016; Deterding, 2015; Seaborn & Fels, 2015).

The findings suggest that a performance-based reward system does not develop a growth mindset in students. Instead, a well-structured and insightful educational environment is necessary to engage and motivate students (Seaton, 2018; Yettick et al., 2016; Rishipal et al., 2019).

Objective 8: To Study the End-User Value of Gamification as a Pedagogy

A value scale for qualitative analysis was given to students in Treatment Group 1, who received gamification as an intervention. The Deci & Ryan (1994) value scale was used, including open-ended and Likert-scale responses. The responses suggest that gamification has pedagogical value:

- 75 students believed gamification maintained their interest in the curriculum (Deci & Ryan, 2010).
- 69 students strongly believed in the benefits of the activity.
- 57 students rated gamification as important.
- 36 students stated it helped with self-awareness.

These findings align with studies suggesting gamification engages students (Su, 2016; da Rocha Seixas et al., 2016; Stott & Neustaedter, 2013). The results indicate that gamification positively impacts academic performance, growth mindset, and metacognition. Treatment Group 1 outperformed other groups, while the control group showed a decline in performance, potentially due to a lack of interest or novelty in pedagogy.

The findings reveal that gamification as a pedagogical intervention positively influences students' academic performance, growth mindset, and metacognition. Gamified learning fosters critical thinking, problem-solving skills, and student engagement, making it a valuable pedagogical strategy (Chandra et al., 2019; Sarbadhikari & Sood, 2018; Kapp, 2016; Nah et al., 2014).

6. CONCLUSION

The findings of this study indicate a significant improvement in the pre-test and post-test scores of academic performance among students in Treatment Group 1. The greatest change was observed in the growth mindset, compared to academic performance and metacognition. This suggests that gamification as an intervention has the potential to enhance students' perceptions of their abilities by increasing their sense of competence. There was a significant improvement in students' academic performance, growth mindset, and metacognition following the implementation of gamification.

The impact of gamification was more pronounced in project work compared to class tests and classroom activities. As project work provided students with greater autonomy and flexibility, the observed difference may have been higher. The opportunity to choose from multiple topics likely contributed to increased interest and perceived competence, resulting in better performance. A positive change was observed in students' beliefs about the malleability of intelligence, the relative importance of learning versus performance, and their attitudes toward effort and mistakes, demonstrating the strong impact of gamification on their growth mindset. Additionally, an upward trend in metacognitive awareness, particularly in knowledge and regulation of cognition, suggests that gamification positively influenced

students' ability to reflect on and regulate their learning. Notably, the most significant change was observed in students' application of debugging strategies to solve problems, while the least change was seen in their use of procedural memory.

A slight increase in growth mindset was also observed after conventional teaching methods, indicating the possible presence of extraneous variables such as syllabus content, student-instructor rapport, motivation, or a conducive learning environment. However, a slight decline in metacognition was noted when conventional teaching methods were used. Additionally, students' academic performance deteriorated slightly under conventional teaching conditions.

A significant difference was found between the academic performance, growth mindset, and metacognition of students in Treatment Group 1 and the Control Group. This suggests that gamification had a substantial impact on students' academic performance, growth mindset, and metacognition. Students in Treatment Group 1 demonstrated higher academic performance, particularly in project work, where they perceived greater autonomy due to the flexibility of choosing topics and the opportunity to resubmit assignments. Although a higher growth mindset was observed among these students, their perception of their ability to change their intelligence showed minimal variation. While a positive shift in metacognitive awareness was noted, little difference was observed in their use of information management strategies and procedural knowledge.

A significant difference in growth mindset was observed between Treatment Group 2 and both Treatment Group 1 and the Control Group. However, no significant differences were found in academic performance and metacognition between Treatment Group 2 and the Control Group. This suggests that conventional teaching methods impact students' growth mindset only when compared to an interactive curriculum. Additionally, a significant difference in growth mindset and metacognition was found between Treatment Group 2 and Treatment Group 1, though there was no significant difference in academic performance. This implies that gamification significantly impacts students' growth mindset and metacognition, particularly when compared to an interactive curriculum.

No significant changes in academic performance, growth mindset, or metacognition were observed following the implementation of an interactive curriculum alone. This may be due to unclear objectives, distractions, and the absence of the advantages provided by game elements. The findings suggest that gamification is a stronger predictor of academic performance and metacognition due to the "freedom to fail" aspect. However, growth mindset findings were mixed, likely influenced by motivational factors and personality traits. The study indicates that an interactive curriculum alone does not support growth mindset development effectively and, without clear goals, may create confusion among students.

A significant difference in growth mindset was observed between students in Treatment Group 3 and the Control Group. However, no significant differences were found in academic performance and metacognition between Treatment Group 3 and the Control Group. This suggests that conventional teaching methods influence growth mindset only when compared to a performance-based reward system. No significant improvements in academic performance, growth mindset, or metacognition were observed due to the performance-based reward system.

Overall, the study reveals a significant positive relationship between mindset and metacognition. However, no significant correlation was found between mindset and academic performance, nor between metacognition and academic performance. Since only one-fourth of the 440 students (110) received gamification as an intervention, the findings suggest that unless a more engaging and objective-driven learning environment is provided, students may

struggle to translate their motivation into improved academic outcomes. It is crucial for students to believe in their abilities and develop self-awareness about their learning, and game-based learning has the potential to support this.

The interaction between growth mindset and metacognition as a moderating factor did not significantly affect academic performance. Additionally, there was no indirect effect of different interventions on academic performance. The findings suggest that a performance-based reward system negatively impacted academic performance compared to other groups. Furthermore, autonomous motivation did not moderate academic performance, nor was there an interaction effect between autonomous motivation and different learning interventions. The study highlights the greater likelihood that changes in the learning environment influence academic performance.

Factors of intrinsic motivation, such as interest, perceived competence, effort, tension, and perceived choice, did not significantly mediate students' growth mindset. Consequently, the performance-based reward system was ineffective in fostering a growth mindset. A well-structured and insightful educational environment is necessary to engage and motivate students. While students acknowledged the value of gamification as a pedagogical strategy and its ability to sustain their interest in the curriculum, their willingness to participate in gamified activities varied. Many students believed gamification was an important aspect of their learning experience, with some recognizing its impact on self-confidence, self-reflection, mental awareness, value development, motivation, and inspiration.

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