Iranian Distance Education Journal *Open Access*

winter-Spring (2025) 7 (1): 149-164
DOI: 10.30473/idej.2025.75054.1245

ORIGINAL ARTICLE

Enhancing Learning, fun, and Learning interest through Juiciness in Gamified Education

Erfane Golshan[1], Yousef Mahdavinasab[2], Sara nouri[3], Mahsa Moradi[4]

1. Department of Educational Technology, Kharazmi University, Tehran, Iran
2. Department of Educational Technology, Kharazmi University, Tehran, Iran
3. Department of Educational Technology, Kharazmi University, Tehran, Iran
4. Department of Educational Technology, Allameh Tabataba'i University, Tehran, Iran

Correspondence:
Yousef Mahdavinasab
Email:
yousef.m@khu.ac.ir

Received: 3/July/2025
Accepted: 22/August/2025

How to cite:
Golshan, E; Mahdavinasab, Y; nouri, S; Moradi, M (2025)., Enhancing Learning, fun, and Learning interest through Juiciness in Gamified Education, **Iranian Distance Education Journal**, 7 (1), 149-164.
DOI: 10.30473/idej.2025.75054.1245

ABSTRACT

This study investigated the impact of juiciness-enhanced gamified leaderboards on learning, fun, and learning interest in fourth-grade literature education. the research employed a quasi-experimental, applied quantitative pretest–posttest design with a control group. A sample of 75 fourth-grade female students from a school in District 18 of Tehran was selected through convenience sampling and randomly assigned to three groups: the Juiciness Leaderboard group (JLG), the Simple Leaderboard group (SLG), and the Control Group (CG). Research instruments included a 16-item parallel-form learning test, the 18-item Fun Questionnaire (FunQ), and a 9-item learning interest questionnaire. The intervention lasted six weeks, using standard literature curriculum materials. Statistical analyses with pairwise comparisons showed that the JLG significantly outperformed both the SLG and CG in learning outcomes, fun, and learning interest, while the SLG also performed significantly better than the CG across all variables. The findings indicate that the design of leaderboards plays a critical role in shaping students' educational experiences. Specifically, the Juiciness Leaderboard intervention consistently produced superior outcomes compared to both the Simple Leaderboard and the Control group, highlighting the added value of sensory-rich features in fostering fun, learning interest, and academic achievement. This study contributes to the growing literature on gamification by emphasizing the importance of incorporating juiciness-enhanced elements into educational environments. By leveraging such strategies, educators can create more dynamic and immersive learning contexts that not only boost short-term performance but also nurture sustained motivation and a lifelong interest in learning.

KEYWORDS

Gamification, Juiciness, Learning, Leaderboards, Learning Interest, Fun

EXTENDED ABSTRACT

INTRODUCTION

Gamification, the integration of game design elements into non-game contexts, has gained traction in educational settings as an effective strategy to boost student motivation and performance (Sanchez et al., 2019; Deterding et al., 2011). Common gamification components, such as scores, badges, progress systems, feedback, and leaderboards, have been widely adopted due to their potential to enhance learning outcomes (Chiu & Nah, 2017; Seaborn & Fels, 2015). They can boost motivation (Park & Kim, 2021; Mekler et al., 2013; Mekler et al., 2017), stimulate interest and cooperative learning (Barata et al., 2013; Simões et al., 2015; Park & Kim, 2021), and promote engagement (Domínguez et al., 2013; Mekler et al., 2013). Among these, leaderboards have received significant attention for their ability to influence student behavior by providing clear objectives and fostering a competitive yet engaging environment (Domínguez et al., 2013; Wang & Sun, 2011). The competitive aspect of leaderboards can lead to positive emotional responses, such as increased interest and enjoyment, which are essential for maintaining long-term engagement (Brom et al., 2016; Cagiltay et al., 2015; Simões et al., 2015).

Despite their benefits, effective design strategies for leaderboards are often not well-defined (Park & Kim, 2021). This highlights the need for further research into how various design elements, including those that enhance visual and sensory appeal, can optimize leaderboard effectiveness in educational settings (Park & Kim, 2021). Understanding how to incorporate "juiciness," or rich audiovisual feedback, is crucial for enhancing learner experiences (Hicks, 2020; Saraceno, 2019).

The concept of "juiciness" in gamification pertains to the integration of rich audiovisual feedback designed to enhance user experience and satisfaction (Hicks, 2020; Saraceno, 2019). This approach, characterized by engaging and abundant visual and auditory stimuli, aims to boost users' sense of competence and contribute significantly to overall enjoyment and the quality of the game experience (Swink, 2008; Hicks et al., 2018). Juiciness involves elements such as dynamic feedback and visually stimulating responses, which are crucial for creating a positive feel and enhancing user engagement (Schell, 2006; Deterding et al., 2015). Beyond the gaming context, juiciness has applications in data visualization and interactive media, reflecting its broader relevance (Durmanova, 2022). In educational settings, incorporating juiciness into gamified elements like leaderboards can potentially enhance student motivation and engagement. This involves adding vibrant visuals and dynamic feedback to educational tools, which aligns with findings that such features can improve learner motivation and performance (Cheung et al., 2017; Chiu & Nah, 2017).

Despite its increasing prominence, the exact definition of juiciness remains somewhat vague, suggesting a need for further research to elucidate its components and effects in various contexts (Vanden Abeele et al., 2015). While juiciness has been shown to improve player experience in gaming (Buckthal, 2014; Juul, 2010), its impact on educational outcomes, particularly in gamified learning environments, is less understood. Existing studies have demonstrated that juiciness can make educational tools more engaging and enjoyable, thereby fostering greater student interest and involvement (Papadimitriou, 2024; Koster, 2005). However, the relationship between the juiciness and other game design elements remains ambiguous and requires empirical investigation (Buckthal, 2014; Rodrigues et al., 2023).

Among the various gamification elements, leaderboards have been widely used to foster motivation and engagement. However, their design strategies remain underexplored, particularly regarding the integration of sensory-rich features. Gamification, broadly defined as the use of game design elements in non-game contexts, has gained considerable traction in education as a means to enhance student motivation and performance (Deterding et al., 2011; Sanchez et al., 2019). Previous studies have demonstrated the effectiveness of core gamification components—such as points, badges, and leaderboards—in improving participation, motivation, and learning outcomes (Domínguez et al., 2013; Chiu & Nah, 2017; Barata et al., 2013). More recently, the concept of “juiciness,” referring to rich audiovisual feedback, has been shown to enhance player

experience in digital games (Hicks et al., 2018, 2019, 2020; Juul & Begy, 2016), with emerging evidence pointing to its potential in educational settings as well (Durmanova, 2022; Papadimitriou, 2024). Nevertheless, its specific role in gamified classroom contexts remains insufficiently understood.

Incorporating juiciness into educational leaderboards can enhance their effectiveness by making learning experiences more enjoyable and motivating. Juicy design elements—offering immediate, dynamic feedback and visually appealing features—can significantly boost learning interest and student engagement (Tisza & Markopoulos, 2023; Cheung, 2017). Therefore, understanding and applying the principles of juiciness is crucial for optimizing gamified learning tools and improving educational outcomes (Hicks, 2020; Papadimitriou, 2024). Building upon this foundation, the present study investigates the impact of juiciness-enhanced leaderboards on fourth-grade students' learning, fun, and learning interest in literature education. By comparing juicy leaderboards with simple leaderboards and traditional classrooms, the study aims to address existing gaps in the literature and provide practical insights for designing more effective gamified learning environments.

Theoretical Foundations

Visual Embellishments in HCI

In Human-Computer Interaction (HCI) research, Visual Embellishments (VEs) have been recognized for their role in enhancing user experience without altering system functionality (Bateman et al., 2010; Hicks, K., 2020). VEs, which include elements such as decorative visuals and engaging stimuli, aim to enrich user interaction and improve overall aesthetics (Holmes, 1984; Hicks, K., 2020). Their effectiveness is particularly notable in educational settings, where visualizations can offer significant insights into user engagement and learning outcomes (Alebri et al., 2024).

Studies in this area often focus on how VEs influence information visualization, such as through graphs, revealing that user preferences are strongly influenced by personal experiences and interests (Inbar et al., 2007; Peck et al., 2019; De Haan et al., 2017). Even minor visual enhancements can enhance a system's perceived aesthetic value and usability (Hassenzahl & Monk, 2010; Mahlke, 2008). VEs are also considered hedonistic, contributing to user satisfaction by fulfilling desires for pleasure and self-expression (Hassenzahl, 2006; Alagöz et al., 2010). Effective design thus requires creating compelling and enjoyable experiences (Hicks, K., 2020).

Player Experience

Player Experience (PX) refers to the emotions and perceptions players experience while interacting with a game (Hicks, K., 2020). It encompasses various aspects of game design, including juiciness, which influences how players perceive and enjoy their interactions (Hicks, 2018). Juiciness affects PX by contributing to the overall enjoyment and engagement with the game, making it a crucial factor in understanding player satisfaction and game design effectiveness.

Self-Determination Theory (SDT)

Self-Determination Theory (SDT) offers a valuable framework for examining the motivational aspects of gamified tools, such as juicy leaderboards. SDT suggests that motivation and engagement are enhanced when psychological needs for autonomy, competence, and relatedness are met (Ryan & Vansteenkiste, 2023). Juicy leaderboards can be designed to fulfill these needs by providing continuous, encouraging feedback that highlights progress and achievements, thereby supporting a sense of competence and satisfaction (Hicks, 2020). Recent research indicates that engaging experiences, which align with SDT principles, significantly impact intrinsic motivation by addressing these psychological needs (Hicks, K., 2020).

Research Related Work

In recent years, gamification has emerged as a significant strategy for enhancing engagement and motivation across various domains, with education being a prominent area of focus. The positive effects of gamification on student engagement are well-documented, with numerous empirical studies highlighting the benefits of incorporating game mechanics such as points, leaderboards, and badges. These elements have been shown to significantly

increase student participation, as evidenced by metrics such as the number of posts, frequency of use, and academic scores (Coetzee et al., 2014; Denny, 2013; Bouchrika et al., 2019).

An essential component of gamification is the concept of "juiciness," which refers to the sensory appeal and excitement derived from interacting with game elements. Hicks et al. (2018, 2019) defined juiciness as a phenomenon resulting from the well-integrated design of game mechanics and visuals that provide confirmatory, explicit, and ambient feedback. They emphasized that abundant audiovisual feedback is crucial for fostering a positive player experience. Hicks (2020) further explored the impact of juiciness on player experience through comprehensive research, uncovering its potential to enhance intrinsic motivation and visual appeal in games. Similarly, Durmanova's (2022) thesis examined the effects of juiciness in exergames, revealing that visual embellishments significantly affect participants' enjoyment and motivation.

Schell (2006) introduced a framework for juicy design, underscoring the importance of continuous feedback in creating engaging experiences. This concept was further elaborated by Deterding et al. (2015), who highlighted the sensory aspects of juiciness and its role in enhancing perceived player competence. Industry discussions on juiciness also stress the importance of polished aesthetics and immersive experiences (Hagen, 2011). Empirical studies have explored the effects of juiciness on player experience, with Juul and Begy (2016) investigating its impact in casual games and Kao (2020) assessing various levels of juicy effects in action role-playing games. These studies reveal the benefits of juiciness while also suggesting the need for moderation. Atanasov (2013) noted the positive emotional responses and sense of reward associated with juiciness in game design.

Hicks et al. (2018) provided a comprehensive framework for juicy design in their paper "Good Game Feel: An Empirically Grounded Framework for Juicy Design." This framework, developed through industry insights and academic research, offers valuable guidance for understanding and operationalizing juiciness in game design.

Research on leaderboards and their impact on students has also been significant. Chiu and Nah (2017) investigated the use of leaderboards in education and found that they could enhance student motivation and engagement. Their study involved assigning optional weekly tasks to students, with leaderboards introduced in the second half of the semester. This approach aimed to determine if leaderboards could stimulate assignment completion and improve student engagement. Their findings offer important insights for educators seeking effective methods to boost motivation and participation.

Leaderboards provide clear goals for learners, which can enhance performance and prevent a decline in engagement over time (Mekler et al., 2013). They also help students track their progress and encourage further effort (Seaborn, Pennefather, & Fels, 2013). Additionally, leaderboards motivate learners to take early actions, especially if their initial performance is lacking, allowing them to aim for personal improvement and maintain motivation (Wang & Sun, 2011). The competitive nature of leaderboards can also elicit positive emotional responses, such as increased interest, enjoyment, attention, excitement, and involvement, which are crucial for long-term engagement in educational video games (Brom et al., 2016; Cagiltay et al., 2015; Simões et al., 2015).

Despite the extensive research on gamification, there remain gaps in understanding its methodologies and results (Hamari et al., 2014). There is also a misconception that gamification simply involves adding point, badge, or leaderboard systems without effectively integrating these elements into educational processes (Wood & Reiners, 2015). Although some research has shown significant positive impacts of juiciness on player experience (Atanasov, 2013; Hicks, 2019), other studies report mixed results (Juul et al., 2016; Singhal & Schneider, 2021).

This study aims to address this gap by exploring the concept of "juiciness"—a term used to describe rich, feedback—and its impact on student learning, fun and learning interest in literature education. It will explore the effects of juiciness-enhanced leaderboards compared to simple leaderboards and conventional classrooms. The study seeks to address the following hypotheses:

1) There is a significant difference in the impact of using juiciness leaderboards compared

to simple leaderboards on students' learning, fun, and learning interest;

2) There is a significant difference in the impact of using juiciness leaderboards compared to conventional classrooms on students' learning, fun, and learning interest;

3) There is a significant difference in the impact of using simple leaderboards compared to conventional classrooms on students' learning, fun, and learning interest.

Methodology

Research Design:

This study employed a **quasi-experimental, applied quantitative design** using a pretest–posttest structure with a control group to examine the impact of different leaderboard designs on student learning outcomes. The research involved three groups: a Juiciness Leaderboard group (JLG), a Simple Leaderboard group (SLG), and a Control Group (CG) with no leaderboard intervention. This quasi-experimental design was chosen because full randomization at the classroom level was not feasible, yet the method allowed for systematic comparison while controlling for potential confounding variables. The approach enabled us to isolate the effects of the independent variables—types of leaderboards—on the dependent variables, which include learning performance, perceived fun, and learning interest.

Table 1: Research Design Diagram

Groups	Participants	Pre-Test Learning	Pre-Test Fun	Pre-Test Learning Interest	Independent Variable	Post-Test Learning	Post-Test Fun	Post-Test Learning Interest
G1	25	T1	T2	T3	X1 (Juiciness Leaderboard group (JLG),)	T4	T5	T6
G2	25	T1	T2	T3	X2 (Simple Leaderboard group (SLG)).	T4	T5	T6
G3	25	T1	T2	T3	X3 (Control Group (CG))	T4	T5	T6

Research Population and Sampling:

The research was conducted with fourth-grade students at a girls' elementary school in District 18 of Tehran, selected using a convenience sampling method. The selection of this particular school was influenced by two main factors: first, the agreement of the school to participate in the study, and second, the accessibility provided by one of the researchers being employed as a teacher at the school. This facilitated better management and control of the research process. Furthermore, the school had at least three classes in the fourth grade, which was essential for the implementation of the research protocol.

Initially, 80 students were considered eligible to participate. After obtaining written parental consent and student assent, three students declined participation, leaving 77. These students were randomly assigned to three groups: the Juiciness Leaderboard Group (26 students), the Simple Leaderboard Group (25 students), and the Control Group (26 students). During the study, two students were excluded (one from the control group due to missing both pre- and post-tests, and one from the juiciness group due to absence in more than 20% of the sessions), resulting in a final sample of 75 students for analysis.

Inclusion criteria:

- ≠ Female fourth-grade students actively enrolled in the same school during the entire study period.
- ≠ Proficiency in Persian language appropriate for grade level, with no reported severe visual/hearing impairments interfering with participation.
- ≠ Ability to attend both pre-test and post-test sessions.
- ≠ No concurrent enrollment in external private classes directly overlapping with the content of the intervention.

≠ Provision of written parental consent and student assent.

Exclusion criteria:

≠ Absence from more than 20% of intervention sessions (two or more).
≠ Failure to attend pre-test or post-test assessments.
≠ Non-adherence to the study protocol (e.g., failing to complete required tasks in multiple sessions).
≠ Starting parallel private tutoring aligned with the intervention content during the study.
≠ Transfer to another school or withdrawal from the current school.
≠ Acute medical conditions preventing regular attendance.

The final sample size (n = 75) met the requirements for MANCOVA analysis, as determined using G*Power software, assuming a medium effect size (0.5), a significance level of 0.05, and a statistical power of 0.80. Although a smaller sample size would have sufficed, 75 participants were retained to ensure robustness of the results. Participants were matched in terms of academic and socioeconomic background to enhance comparability across groups. Ethical approval was obtained from the school administration, and informed consent was secured from parents.

Research Instruments:

1. **Learning Test:** A customized 16-item test was administered both before and after the intervention to measure learning outcomes. The test's validity was evaluated using the Content Validity Ratio (CVR), with an agreement rate of 80%. Reliability was confirmed with a Cronbach's Alpha of 0.754. Parallel forms were utilized for the pretest and posttest to minimize learning effects from repeated exposure to the same items.
2. **Fun Test:** The Fun Questionnaire (FunQ), developed by Tisza and Markopoulos (2023), was used to assess the enjoyment of learning activities. This tool includes 18 items across six dimensions: Autonomy, Challenge, Delight, Immersion, Loss of Social Barriers, and Stress. The questionnaire demonstrated strong reliability with an overall omega (ωoverall) of 0.875 and partial reliability (ωpartial) of 0.864, indicating a good model fit (RMSEA = 0.052, SRMR = 0.072).
3. **Learning Interest Test:** Learning interest was measured using a 9-item questionnaire adapted from Hong et al. (2014), with responses rated on a 5-point Likert scale. The reliability and validity of the questionnaire were confirmed by Tsai, Lin, Hong, and Tai (2018), with Composite Reliability (CR) values ranging from 0.84 to 0.90, Average Variance Extracted (AVE) exceeding 0.5, and high internal consistency (Cronbach's alpha for Liking = 0.85, Enjoyment = 0.90, Engagement = 0.84)

Procedure

After selecting the research sample, students were randomly assigned to one of three groups: The Juiciness Leaderboard Group (JLG), the Simple Leaderboard Group (SLG), and the Control Group (CG). This random assignment ensured equitable representation across experimental and control conditions. Course materials and assessments were distributed to each group, with personalized instructional materials tailored to their respective interventions.

Over the course of six sessions, various educational activities were conducted to enhance students' reading comprehension, spelling abilities, visual and auditory concentration, and organizational skills. The sessions included tasks such as identifying punctuation marks, creating compound words, writing descriptive paragraphs, recognizing cultural myths, and using transitional words. Each session incorporated different motivational techniques, including storytelling, performances, and visual aids.

Students participated in group discussions, question-and-answer sessions, and individual writing tasks. Each session concluded with a fifteen-question quiz to assess comprehension and skill acquisition. Following the quizzes, leaderboards were displayed for the Juiciness Leaderboard Group and the Simple Leaderboard Group, while the Control Group did not see any

leaderboards. The leaderboards for the JLG featured gamified elements to enhance motivation, as shown in Figure 1, whereas the SLG viewed basic text-based leaderboards.

Implementation Process and Juiciness Design

1. Design of the Quiz and Scientific Competition:

- After each lesson, a set of questions based on the content presented was designed, and a scientific competition was held for the students.
- Each quiz consisted of 10 questions, combining multiple-choice and open-ended formats. Students were required to write their answers on paper.
- The teacher then collected and graded the responses. Instead of assigning traditional grades, points were awarded to create a sense of play and enjoyment in the learning process. This approach aimed to reduce stress and foster a game-like experience for the students.

2. Leaderboard Design:

- Based on the points earned in the quiz, a leaderboard was created by the class teacher. This leaderboard displayed the rankings of the students.
- To ensure that a single position was not assigned to only one student and to mitigate any negative impact, the competition in the leaderboard was structured with score ranges. For instance, scores between 90 and 100 were categorized as the first rank, scores between 70 and 90 as the second rank, and so on. This allowed for multiple students to share the same rank, emphasizing ranks over individual positions.

3. Juiciness Implementation:

- This process was meticulously designed based on the concept of "juiciness," which emphasizes the use of rich visual and audio feedback to enhance user engagement (Juul et al., 2016; Hicks et al., 2018).
- The students' images were obtained from their profiles on the school's social network and were used in the leaderboard design to create a greater sense of ownership and presence.
- Audio and Visual Effects:
  - To enhance engagement and create a positive experience, the leaderboard was augmented with visual and audio effects, such as medals, cheering sounds, trumpet blasts, balloon ascents, and other celebratory animations.

Figure 1: An example of a juiciness-enhanced leaderboard[1]

1. All images of students have been intentionally blurred to protect their identities and to ensure compliance with ethical research standards

- These effects were incorporated into the leaderboard using the InShot application and PowerPoint. The selection of InShot was due to its user-friendly interface, which allowed teachers to design and edit leaderboards easily without taking much time. A common template with images, rankings, numbers, etc., was used, and each time the positions and visual effects were updated accordingly.
- In each class, students who ranked in the top five positions received special visual and audio effects, including rank medals next to their names. Up to the sixth position, students were encouraged and their ranks were displayed. The remaining students' ranks and images were also shown, but with different, more subdued sound effects to ensure a healthy and stress-free competition.

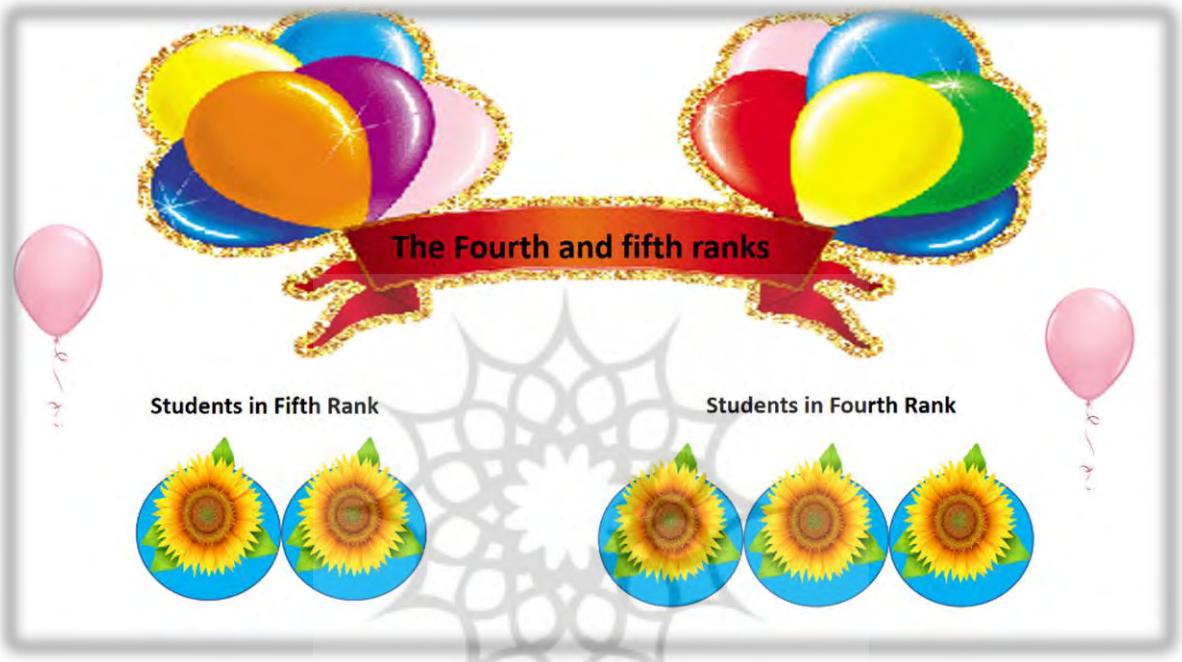

Figure 2: example of student rankings on the leaderboard

4. Session-by-Session Display and Adjustments:

- The juiced leaderboards were projected in the classroom during each session, allowing all students to view the rankings. This was done in person using the classroom computer and a video projector to display the video and leaderboards.
- To maintain interest and excitement, the visual and audio effects were varied in each session. This included different themes such as a cinema-style curtain opening, balloon ascents, and various lighting effects.

This process aimed to integrate gamification elements, particularly juiciness, into the classroom environment to increase motivation, enjoyment, and learning outcomes among the students.

Results

The impact of different leaderboard designs on students' fun, learning interest, and learning outcomes was analyzed using Multivariate Analysis of Covariance (MANCOVA). This statistical technique allowed for the examination of multiple dependent variables (fun, learning interest, and learning outcomes) while controlling for any potential pre-test differences.

Statistical Description:

Table 3 summarizes the means and standard deviations of pre-test and post-test scores for the variables of fun, learning interest, and learning across the three study groups. Notably, both the Simple Leaderboard Group (SLG) and Juiciness Leaderboard Group (JLG) exhibited a more substantial increase in post-test scores compared to the Control Group (CG).

Table 3. Descriptive Statistics of Pre-test and Post-test Scores for Fun, Learning interest, and Learning Variables by Group.

Group	Variable	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Control	Learning	14.01	4.697	15.59	3.825
	Fun	43.56	10.235	46.44	9.434
	Learning interest	20.96	5.358	23.12	5.207
Simple Leaderboard	Learning	13.64	5.522	17.48	4.295
	Fun	42.56	14.515	51.08	13.159
	Learning interest	21.56	4.823	31.36	5.235
Juiced Leaderboard	Learning	11.04	4.048	17.76	2.858
	Fun	45.88	11.047	58.96	11.212
	Learning interest	21.20	6.677	35.72	5.712

Based on the results of data analysis, the means and standard deviations of pre-test and post-test scores for the variables of fun, learning interest, and learning were evaluated in three study groups.

In the Control group, the mean pre-test and post-test scores for the fun variable were 43.56 and 46.44, respectively. For the learning interest variable, these scores were 20.96 and 23.12, and for the learning variable, they were 14.01 and 15.59. The corresponding standard deviations for these variables were 10.235 and 9.434 for fun, 5.358 and 5.207 for learning interest, and 4.697 and 3.825 for learning.

In the Simple Leaderboard group, the mean pre-test and post-test scores for the fun variable were 42.56 and 51.08, respectively. For the learning interest variable, these scores were 21.56 and 31.36, and for the learning variable, they were 13.64 and 17.48. The corresponding standard deviations for these variables were 14.515 and 13.159 for fun, 4.823 and 5.235for learning interest, and 5.522 and 4.295 for learning.

In the Juiced Leaderboard, the mean pre-test and post-test scores for the fun variable were 45.88 and 58.96, respectively. For the learning interest variable, these scores were 21.20 and 35.72, and for the learning variable, they were 13.64 and 17.48. The corresponding standard deviations for these variables were 11.04 and 11.212 for fun, 6.677 and 5.712 for learning interest, and 4.048 and 2.858 for learning.

Results of Multivariate Analysis of Covariance (MANCOVA):

To compare the levels of fun, learning interest, and learning among the control group, simple leaderboard group (SLG), and juiciness leaderboard group (JLG), a Multivariate Analysis of Covariance (MANCOVA) was employed. Prior to conducting the MANCOVA, a Shapiro-Wilk test was conducted to confirm the normality of score distribution within the samples. The results of the homogeneity of regression slopes test for pre-test and post-test scores in the experimental and control groups indicated that the regression slopes were equal across the groups ($p > 0.05$). The Levene's test results, which assessed the homogeneity of variances of dependent variables among the groups, demonstrated that the variances of the variables related to fun ($p > 0.05$), learning interest ($p > 0.05$), and learning ($p > 0.05$) were equal in the groups. Additionally, the Box's M test, used to evaluate the equality of covariance matrices of dependent variables between the experimental and control groups, indicated that the covariance matrices of the dependent variables in the groups were equal ($p > 0.05$). Moreover, Bartlett's Test of Sphericity was performed to examine the sphericity or meaningfulness of the relationship between variables, revealing a significant relationship ($p < 0.05$).

Table 4. Multivariate Tests for Group Differences

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	.679	11.644	6.000	136.000	.000
Wilks' lambda	.331	16.472[a]	6.000	134.000	.000
Hotelling's trace	1.989	21.879	6.000	132.000	.000
Roy's largest root	1.974	44.738[b]	3.000	68.000	.000

Multivariate analysis was conducted to assess the overall differences between groups., Wilks' lambda indicated a significant effect, $\lambda = 0.331$, $F(6, 134) = 16.472$, $p < .001$. These results suggest substantial differences among the groups across multiple dependent variables.

For a more detailed examination of differences and the impact of each intervention across the experimental groups, pairwise follow-up tests were conducted. These tests allow for pairwise comparisons between each pair of groups, enabling us to determine which intervention was more effective and which group performed better in terms of dependent variables. In Table 5, the results of the pairwise follow-up tests will be presented.

Table 5. Pairwise Comparisons of Group Mean Differences

Dependent Variable	(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.[b]
learning	control	Simple Leaderboard	-2.059*	.692	.012
		Juiced Leaderboard	-3.981*	.715	.000
	Simple Leaderboard	control	2.059*	.692	.012
		Juiced Leaderboard	-1.923*	.713	.026
	Juiced Leaderboard	control	3.981*	.715	.000
		Simple Leaderboard	1.923*	.713	.026
fun	control	Simple Leaderboard	-5.462*	1.868	.014
		Juiced Leaderboard	-11.464*	1.931	.000
	Simple Leaderboard	control	5.462*	1.868	.014
		Juiced Leaderboard	-6.002*	1.925	.008
	Juiced Leaderboard	control	11.464*	1.931	.000
		Simple Leaderboard	6.002*	1.925	.008
Learning interest	control	Simple Leaderboard	-8.251*	1.502	.000
		Juiced Leaderboard	-13.164*	1.553	.000
	Simple Leaderboard	control	8.251*	1.502	.000
		Juiced Leaderboard	-4.914*	1.548	.007
	Juiced Leaderboard	control	13.164*	1.553	.000
		Simple Leaderboard	4.914*	1.548	.007

Pairwise comparisons were conducted to evaluate the differences between groups across various dependent variables. The results are summarized in Table 5.

Regarding "learning," significant differences were identified between the control group and both the Simple Leaderboard group (Mean Difference = -2.059, $p = .012$) and the Juiced Leaderboard group (Mean Difference = -3.981, $p < .001$). Similarly, significant differences were found between the Simple Leaderboard and Juiced Leaderboard groups (Mean Difference = -1.923, $p = .026$).

For the variable "fun," significant differences were observed between the control group and both the Simple Leaderboard group (Mean Difference = -5.462, $p = .014$) and the Juiced Leaderboard group (Mean Difference = -11.464, $p < .001$). Similarly, significant differences were found between the Simple Leaderboard and Juiced Leaderboard groups (Mean Difference = -6.002, $p = .008$).

In terms of "learning interest," significant differences were detected between the control group and both the Simple Leaderboard group (Mean Difference = -8.251, $p < .001$) and the Juiced Leaderboard group (Mean Difference = -13.164, $p < .001$). Additionally, significant differences were observed between the Simple Leaderboard and Juiced Leaderboard groups (Mean Difference = -4.914, $p = .007$).

These findings highlight the variations in outcomes between different intervention groups, underscoring the importance of considering the effectiveness of each intervention in enhancing the measured variables.

Discussion

The present study investigated the impact of juiciness-enhanced gamified leaderboards on learning, fun, and learning interest among fourth-grade literature students. The findings support all three hypotheses proposed, demonstrating significant differences between the Juiciness Leaderboard Group (JLG), the Simple

Leaderboard Group (SLG), and the Control Group (CG) across the measured variables.

The first hypothesis posited that students in the Juiciness Leaderboard condition would outperform those in the Simple Leaderboard and Control groups in learning outcomes. Consistent with this hypothesis, the results revealed that the JLG achieved significantly higher scores on the posttest compared to both the SLG and CG. These findings highlight the critical role of juiciness-enhanced feedback in enhancing educational achievement. Similar outcomes have been emphasized in prior studies showing that leaderboards stimulate student participation, enhance goal-setting behaviors, and foster healthy competition among learners (Chiu & Nah, 2017; Domínguez et al., 2013; Mekler et al., 2013; Barata et al., 2013). Our findings extend this line of research by showing that juiciness—through abundant audiovisual feedback—further amplifies these positive effects in classroom contexts (Hicks et al., 2018, 2019; Hicks, 2020). By contrast, the SLG, which lacked such rich audiovisual features, also outperformed the CG but to a lesser extent, indicating that the gamified competitive element alone can improve learning but is substantially augmented by juiciness features. This pattern confirms theoretical predictions from gamification research emphasizing the motivational power of immediate, rich feedback (Swink, 2008; Hicks, 2020).

Regarding the second hypothesis, the study predicted that the juiciness-enhanced leaderboards would generate more fun compared to simple leaderboards and conventional classrooms. The results strongly support this prediction, as students in the JLG reported the highest levels of fun on the Fun Questionnaire. The incorporation of animated visual effects, celebratory sounds, and personalized avatars likely contributed to heightened enjoyment by stimulating multiple sensory channels simultaneously (Schell, 2006; Hicks et al., 2018). Notably, the playful presentation of achievements, such as balloon ascents, rank medals, and trumpet blasts, helped transform assessment moments into enjoyable experiences, reducing performance anxiety and promoting positive emotional responses. This aligns with insights from game design research emphasizing that abundant audiovisual feedback is crucial for creating immersive and enjoyable experiences (Hicks et al., 2018, 2019; Hicks, 2020). Similar to our results, prior educational studies have highlighted the potential of playful leaderboard designs to foster enthusiasm and fun in learning (Cheung, 2017; Prihatini, 2017). The SLG also reported more fun than the CG, reaffirming previous findings that competitive gamified elements foster engagement, although without the added juiciness elements, the affective impact was comparatively limited (Domínguez et al., 2013; Park & Kim, 2021).

The third hypothesis predicted a significant increase in learning interest for students exposed to juiciness-enhanced leaderboards. Consistent with this, the JLG exhibited the highest levels of learning interest, followed by the SLG and CG. The juiciness-enhanced design likely contributed to a more immersive learning environment, capturing students' attention and sustaining curiosity over the six-week intervention. Interest in learning has been identified as a crucial determinant of engagement and achievement (Cheung, 2017; Prihatini, 2017). In line with this, our results show that tailoring juicy elements—such as students' favorite tunes, personal photos, and child-friendly graphics (e.g., shooting stars)—strengthened their sense of presence and belonging, thereby fostering deeper learning interest. The structured scoring ranges in the leaderboard also mitigated potential negative effects of competition, enabling multiple students to achieve the same rank and fostering a sense of collective progress.

The findings underscore the importance of juiciness as a design principle in educational gamification. By integrating visually stimulating and auditory feedback, the JLG provided a richer player experience (PX), enhancing emotional engagement and reinforcing learning behaviors. Previous studies in gaming and HCI have emphasized that sensory-rich interactions contribute to positive affect, competence perception, and overall engagement (Hicks et al., 2018; Swink, 2008; Schell, 2006). Extending this principle to educational contexts, the current study demonstrates that juiciness can effectively transform routine classroom assessments into

motivating, enjoyable experiences that bolster both cognitive and affective outcomes.

Practical Implications

From a practical perspective, these findings offer clear guidance for educators aiming to leverage gamification in classrooms. Implementing juiciness-enhanced leaderboards does not require complex technology; as demonstrated, applications like InShot and PowerPoint enabled teachers to design engaging audiovisual feedback easily. The session-by-session variation of effects and themes helped sustain interest over time, highlighting the importance of novelty and dynamic feedback in maintaining engagement. Moreover, the use of personalized avatars reinforced student ownership and social presence, which can further motivate participation and effort.

Conclusion

In conclusion, this study confirms that juiciness-enhanced gamified leaderboards significantly improve learning outcomes, fun, and learning interest compared to both simple leaderboards and conventional classrooms. The results support all three hypotheses, emphasizing the value of rich audiovisual feedback as a powerful tool to enhance student engagement and achievement. By demonstrating that juiciness can transform traditional educational assessments into motivating, immersive experiences, this research contributes both theoretically and practically to the literature on gamification in education. Incorporating juiciness principles provides a viable, scalable strategy to foster enjoyment, sustained motivation, and meaningful learning in classroom settings.

1.1.1. Limitations of the Study:

The study has several limitations that should be considered. First, the relatively small sample size, which consisted of fourth-grade female students from District 18 of Tehran using a convenience sampling method, may affect the generalizability of the results. Therefore, caution is needed when generalizing the findings to broader populations, and future research should involve larger and more diverse samples to enhance generalizability. Second, the short duration of the intervention, spanning only six weeks, may not have been sufficient to capture long-term effects or changes in student behavior and attitudes towards learning. Extending the duration of the study and conducting follow-up assessments could provide a more comprehensive understanding of the sustained impact of juiciness-enhanced leaderboards on student learning outcomes.

Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that there are no conflicts of interest in this study.

References

Alagöz, F., Valdez, A. C., Wilkowska, W., & Holzinger, A. (2010). *From cloud computing to mobile Internet, from user focus to culture and hedonism: The crucible of mobile health care and wellness applications*. In *Pervasive Computing and Applications (ICPCA), 2010 5th International Conference on* (pp. 35-41). IEEE. https://doi.org/10.1109/ICPCA.2010.5704072

Alebri, M., Costanza, E., Panagiotidou, G., & Brumby, D. P. (2024). Embellishments revisited: Perceptions of embellished visualisations through the viewer's lens. *IEEE Transactions on Visualization and Computer Graphics, 30*(1), 1424-1434. https://doi.org/10.1109/TVCG.2023.3326914

Atanasov, S. (2013). *Juiciness: Exploring and designing around experience of feedback in video games* (Master's thesis, Malmö högskola, Faculty of Culture and Society). Malmö högskola/Kultur och samhälle. https://urn.kb.se/resolve?urn=urn:nbn:se:mau:diva-22264

Barata, G., Gama, S., Jorge, J. A. P., & Gonçalves, D. (2013). So fun it hurts – Gamifying an engineering course. In *Proceedings of the HCI International Conference* (pp. 586-595). Springer. https://doi.org/10.1007/978-3-642-39454-6_68

Bateman, S., Mandryk, R. L., Gutwin, C., Genest, A., McDine, D., & Brooks, C. (2010). Useful junk?: The effects of visual embellishment on comprehension and memorability of charts. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2573–2582). ACM. https://doi.org/10.1145/1753326.1753716

Bouchrika, I., Harrati, N., Wanick, V., & Wills, G. (2019). Exploring the impact of gamification on student engagement and involvement with e-learning systems. *Interactive Learning Environments*, 27(6), 832-845. https://doi.org/10.1080/10494820.2019.1623267

Brom, C., Šisler, V., Slussareff, M., Selmbacherová, T., & Hlávka, Z. (2016). You like it, you learn it: Affectivity and learning in competitive social role play gaming. *International Journal of Computer-Supported Collaborative Learning, 11*(3), 313-348. https://doi.org/10.1007/s11412-016-9237-3

Buckthal, E. D. (2014). *Juiciness in citizen science computer games: Analysis of a prototypical game*. California Polytechnic State University. DOI: https://doi.org/10.15368/theses.2014.122

Cagiltay, N. E., Özçelik, E., & Şahin Özçelik, N. (2015). The effect of competition on learning in games. *Computers & Education, 87*, 35-41. https://doi.org/10.1016/j.compedu.2015.04.001

Cheung, D. (2017). The key factors affecting students' individual interest in school science lessons. *Research in Science & Technological Education, 35*(1), 1-23. https://doi.org/10.1080/09500693.2017.1362711

Chiu, Y.-H., & Nah, F. F.-H. (2017). *Effects of the use of leaderboards in education*. In *Proceedings of the [Conference Name]*. Retrieved from https://api.semanticscholar.org/CorpusID:201050283

Coetzee, M., Schreuder, D., & Tladinyane, R. T. (2014). Employees' work engagement and job commitment: The moderating role of career anchors. *SA Journal of Human Resource Management, 12*(1), 1-12. https://doi.org/10.4102/sajhrm.v12i1.572

de Haan, Y., Kruikemeier, S., Lecheler, S., & van der Nat, R. (2017). When does an infographic say more than a thousand words?: Audience evaluations of news visualizations. *Journalism Studies, 19*(9), 1-20. https://doi.org/10.1080/1461670X.2016.1267592

Denny, P. (2013). The effect of virtual achievements on student engagement. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 489-498). ACM. https://doi.org/10.1145/2470654.2470763

Deterding, S. (2015). The lens of intrinsic skill atoms: A method for gameful design. *Human-Computer Interaction, 30*(3-4), 294-335.

https://doi.org/10.1080/07370024.2014.993471

Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., & Martínez, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education, 63*(1), 380-392. https://doi.org/10.1016/j.compedu.2012.12.020

Durmanova, K. (2022). *The effects of juicy game design on exergames*. University of Waterloo. http://hdl.handle.net/10012/18980

Hagen, U. (2011). Designing for player experience: How professional game developers communicate design visions. *Journal of Gaming & Virtual Worlds, 3*(3), 259-275. https://doi.org/10.1386/jgvw.3.3.259_1

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? — A literature review of empirical studies on gamification. In *Proceedings of the 47th Hawaii International Conference on System Sciences*. IEEE. https://doi.org/10.1109/HICSS.2014.377

Hassenzahl, M. (2006). Hedonic, emotional, and experiential perspectives on product quality. In *Encyclopedia of human computer interaction* (pp. 266–272). IGI Global. http://dx.doi.org/10.4018/978-1-59140-562-7.ch042

Hassenzahl, M., & Monk, A. (2010). The inference of perceived usability from beauty. *Human–Computer Interaction, 25*(3), 235–260. DOI: 10.1080/07370024.2010.500139

Hicks, K. (2020). *Juicy game design: Exploring the impact of juiciness on the player experience* (Unpublished doctoral thesis). University of Lincoln. https://doi.org/10.24385/lincoln.24326740.v1

Hicks, K., Dickinson, P., Holopainen, J., & Gerling, K. M. (2018). Good game feel: An empirically grounded framework for juicy design. In *Proceedings of the DiGRA Conference*. Retrieved from https://api.semanticscholar.org/CorpusID:55153055

Hicks, K., Gerling, K., Dickinson, P., & Vanden Abeele, V. (2019). Juicy Game Design: Understanding the Impact of Visual Embellishments on Player Experience. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play, CHI PLAY '19*, pages 185–197, New York, NY, USA, October 2019. Association for Computing Machinery. doi: 10.1145/3311350.3347171. URL http://doi.org/10.1145/3311350.3347171

Holmes, N. (1984). *Designer's guide to creating charts & diagrams*. Watson-Guptill Publications. New York.

Hong, J. C., Hwang, M. Y., Liu, M. C., Ho, H. Y., & Chen, Y. L. (2014). Using a "prediction–observation–explanation" inquiry model to enhance student interest and intention to continue science learning predicted by their Internet cognitive failure. Computers & Education, 72, 110-120. https://doi.org/10.1016/j.compedu.2013.10.004

Inbar, O., Tractinsky, N., & Meyer, J. (2007). Minimalism in information visualization: Attitudes towards maximizing the data-ink ratio. In *Proceedings of the 14th European conference on Cognitive ergonomics: invent! explore!* (pp. 185–188). ACM. https://doi.org/10.1145/1362550.13625

Juul, J. (2010). A casual revolution: Reinventing video games and their players. The MIT Press.

Juul, J., & Begy, J. S. (2016, August). Good Feedback for bad Players? A preliminary Study of 'juicy'Interface feedback. In Proceedings of first joint FDG/DiGRA Conference, Dundee.

Kao, D. (2020). The effects of juiciness in an action RPG. Entertainment Computing, 34, 100359. https://doi.org/10.1016/j.entcom.2020.100359

Mahlke, S. (2008). Visual aesthetics and the user experience. In *Dagstuhl Seminar Proceedings*. Schloss Dagstuhl-Leibniz-Zentrum für Informatik. https://doi.org/10.4230/DagSemProc.08292.7

Mekler, E. D., Brühlmann, F., Opwis, K., & Tuch, A. N. (2013). Do points, levels and leaderboards harm intrinsic motivation?: An empirical analysis of common gamification elements. In *Proceedings of the First International Conference on gameful design, research, and applications* (pp. 66–73). ACM. https://doi.org/10.1145/2583008.2583017

Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Computers in human behavior*, *71*, 525-534. https://doi.org/10.1016/j.chb.2015.08.048

Papadimitriou, A. (2024). Theories, Strategies and Elements of Gamified MOOCs: A Systematic Literature Review. *Asia Pacific Journal of Information Systems*, *34*(1), 248-291. https://doi.org/10.14329/apjis.2024.34.1.248

Park, & Kim. (2021). The principles of leaderboard design aimed at enhancing learning and motivation in gamified educational environments. JMIR Serious Games. doi: 10.2196/14746. doi:10.2196/14746

Peck, E. M., Ayuso, S. E., & El-Etr, O. (2019). Data is personal: Attitudes and perceptions of data visualization in rural Pennsylvania. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Paper No. 244, pp. 1-12). ACM. https://doi.org/10.1145/3290605.3300474

Prihatini, E. (2017). Pengaruh Metode Pembelajaran Dan Gaya Belajar Terhadap Hasil Belajar Ipa. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *7*(2), 171–179. https://doi.org/10.24853/instruksional.1.2.152-158

Rodrigues, L., Toda, A. M., Palomino, P. T., Klock, A. C., & Avila-Santos, A. (2023, November). Motivation no Jutsu: Exploring the Power of Badge Aesthetics in Gamified Learning. In *Anais do XXXIV Simpósio Brasileiro de Informática na Educação* (pp. 631-643). SBC. DOI**:** https://doi.org/10.5753/sbie.2023.234313

Ryan, R. M., & Vansteenkiste, M. (2023). Self-determination theory: metatheory, methods, and meaning. In R. M. Ryan (Ed.), The Oxford handbook of self-determination theory (pp. 3–30). https://doi.org/10.1093/oxfordhb/9780197600047.013.2

Sanchez, D. R., Langer, M., & Kaur, R. (2020). Gamification in the classroom: Examining the impact of gamified quizzes on student learning. *Computers & Education, 144 https://doi.org/10.1016/j.compedu.2019.103666

Saraceno, S. (2019). *Meaningful gamification: A new way of improving intrinsic motivation* (Bachelor's thesis, University of Basel). Institute of Psychology, Center for Cognitive Psychology and Methodology.

Schell, J. (2008). *The art of game design: A book of lenses* (English ed.). Morgan Kaufmann.

Schell, J. (2014). *The Art of Game Design: A book of lenses.* AK Peters/CRC Press. (cit. on pp. 1, 2, 18, 19, 21, 28, 46, 98, 130, 133, 136) https://doi.org/10.1201/b17723

Seaborn, K., & Fels, D. (2015). Gamification in theory and action: A survey. *International Journal of Human-Computer Studies*, *74*, 14-31. https://doi.org/10.1016/j.ijhcs.2014.09.006

Seaborn, K., Pennefather, P., & Fels, D. I. (2013). Reimagining leaderboards: Towards gamifying competency models through social game mechanics. In *Proceedings of the First International Conference on Gameful Design, Research, and Applications* (pp. 107-110). ACM. https://doi.org/10.1145/2583008.2583026

Simões, J., Díaz Redondo, R. P., & Fernández Vilas, A. (2015). A social gamification framework for a K-6 social network. *Journal/Conference*, *Volume*(Issue), Page numbers. https://doi.org/10.13140/RG.2.1.2515.1201

Singhal, T., & Schneider, O. (2021). Juicy haptic design: Vibrotactile embellishments can improve player experience in games. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Article No. 126, pp. 1-11). ACM. https://doi.org/10.1145/3411764.3445463

Swink, S. (2008). *Game feel: A game designer's guide to virtual sensation* (1st ed.). Morgan Kaufmann.

Tisza, G., & Markopoulos, P. (2023). FunQ: Measuring the fun experience of a learning activity with adolescents. *Current Psychology*, *42*(3), 1936–1956. https://doi.org/10.1007/s12144-021-01484-2

Tsai, Y. H., Lin, C. H., Hong, J. C., & Tai, K. H. (2018). The effects of metacognition on online learning interest and continuance to learn with MOOCs. Computers & Education, 121, 18-29.

http://dx.doi.org/10.1016/j.compedu.2018.02.011

Vanden Abeele, V., Wouters, J., Ghesquière, P., & Geurts, L. (2015, October). Game-based assessment of psycho-acoustic thresholds. In *Proceedings of the 2015 Annual Symposium* (pp. 1-5). https://doi.org/10.1145/2793107.2793132

Wang, H., & Sun, C. T. (2011). Game Reward Systems: Gaming Experiences and Social Meanings. In *Proceedings of the DiGRA 2011 Conference: Think Design Play*.

Wood, L. C., & Reiners, T. (2015). Gamification. In *Encyclopedia of Information Science and Technology, Third Edition* (pp. 3039-3047). IGI global. http://dx.doi.org/10.4018/978-1-4666-5888-2.ch297