International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning

Udorn Sudsom and Thanawan Phongsatha
Graduate School of Business and Advanced Technology Management Assumption University of Thailand
E-mail: udorn.s@gmail.com ID: https://orcid.org/0009-0001-7656-2048
E-mail: thanawanphn@au.edu ID: https://orcid.org/0000-0003-3918-1796

Received 05/10/2023 Revised 10/10/2023 Accepted 15/10/2023

Abstract

Background and Aim: The study investigates how two assessment methods, gamification-based and formative-based affect motivation for learning and memory retention strategies in the corporate training setting. The primary objective was to compare the effectiveness s these assessment approaches in learning motivation and in forgetting and retention.

Materials and Methods: In this study, seventy-six employees working at a duty-free retail store in a Middle Eastern airport took part. The participants were divided into two groups. One group took a gamification-based assessment using Kahoot! application, while the other group took a formative-based assessment. Both groups were evaluated for recall and recognition after learning for one week. After two weeks, the content was reviewed, and recall and recognition tests were conducted using Kahoot! application for relearning. Finally, after the assessment, both groups were given a questionnaire about staff motivation in learning.

Results: Gamification has been found to significantly enhance learners' motivation, resulting in improved scores in various areas, including interest-enjoyment, perceived competence, and effort importance. However, it was found that learners felt less tension and pressure. Compared to traditional formative assessments, gamified approaches lead to higher levels of confidence and perceived effort in learning. This method has improved forgetting and retention, demonstrated by higher recall, recognition, and relearning scores. Furthermore, the gamified approach creates a stimulating and challenging learning environment, as decreased tension and pressure indicated.

Conclusion: The study's findings support the existing research, indicating that gamification significantly boosts motivation and improves memory retention in corporate training. These insights reveal the complex relationship between emotions and evaluations during the learning process and highlight the potential of gamified methods in corporate training. Further research should explore the underlying mechanisms and their compatibility with the existing literature on memory and learning processes.

Keywords: Forgetting Retention; Formative-Based Assessment; Gamification-Based Assessment; Motivation for Learning

Introduction

In today's rapidly evolving business landscape, the enduring success and competitive edge of enterprises depend heavily on the strategic emphasis placed on human resources. This distinctive asset cannot be easily replicated (Ozkeser, 2019). Organizations recognize this and strive to cultivate a proficient and highly motivated workforce, understanding that human resources are central to sustainable success.

Training is a crucial aspect of human resources management aimed at improving individual and organizational productivity, which is a critical objective of human resources management (Ozkeser, 2019). It is a systematic approach that ensures individuals acquire the necessary knowledge and skills for optimal job performance. Additionally, the goal of training and development initiatives is to improve current and future performance by increasing the ability of individuals to work efficiently (Poe, 2003). In this context, the voluntary participation of employees, driven by motivations beyond financial compensation, highlights the importance of using training to improve motivation and overall performance.

Retaining knowledge is essential to make training programs effective, as people tend to forget a significant portion of what they learn (Pashler et al., 2007). One promising strategy to overcome this challenge is gamification, which involves integrating game-related elements into non-game contexts (Eugenio et al., 2019; Talingdan et al., 2019; Putra et al., 2019). Gamification can enhance motivation and engagement in learning, making it an ideal approach for corporate training. Using gamification in training can improve memory retention, ensuring the acquired knowledge and skills last longer (Smith et al., 2022). Assessment gamification is also critical in education as it supports effective teaching and

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

learning. It provides valuable data to guide instructional planning and helps achieve educational objectives (Linn & Miller, 2005). As the educational scenery continues to evolve, innovative and active learning strategies are necessary to improve employee engagement and knowledge acquisition in corporate training.

Ozkeser's study (2019) sheds light on various factors that influence employee motivation, categorizing them as economic, psycho-social, and organizational and managerial tools. This research further investigates how educational activities impact employee motivation in the context of organizational and managerial motivation tools. Additionally, it addresses a significant research gap by exploring how gamification can be used as an assessment tool in corporate training to mitigate forgetting and retention. The study also considers employee motivation for learning. It employs a Forgetting and Retention model, focusing on Recall, Recognition, and Relearning as variables to assess the effectiveness of training and development in a corporate setting.

Objectives

1. To evaluate how the motivation of learning differs between Gamification-Based and Formative-Based assessments in the context of corporate training.
2. To compare the effectiveness of forgetting and retention strategies between Gamification-Based and Formative-Based assessments.

Literature review

In the literature review, researchers present a comprehensive review of the literature in five key research areas. These areas include gamification-based assessment, motivation for learning, and forgetting and retention. The second part of the chapter provides specific information about the population, while the third part explores the relationships between the population and the research mentioned above topics. The fourth section covers the Theoretical Framework and Previous Literature, and the final part reviews the Conceptual and Research Framework. Our goal is to provide an extensive overview of relevant theories, concepts, and research findings related to these subjects, which are categorized into various sub-sections.

Gamification-based Assessment

Gamification has been the subject of considerable research in education. Studies have explored its impact on motivation and learning outcomes across various subjects, including science, mathematics, and human anatomy. Empirical evidence supports the notion that gamification can enhance motivation and improve educational outcomes. Research has covered various aspects of gamification, ranging from using Kahoot! as a formative assessment tool to developing game-based assessment tools. The Framework for Gamified Programming Education project aims to establish prerequisites for implementing gamification in programming education. These studies highlight how gamification can elevate student engagement and performance in diverse academic domains.

Several studies have investigated the potential of gamification in improving academic performance. For instance, Ang et al. (2018) found that gamification can enhance the motivation of first-year medical students in self-directed learning of human anatomy, ultimately leading to improved academic performance. Kepceoglu (2019) explored prospective science education teachers' opinions on gamification in education, finding it more effective than traditional approaches. Ismail et al. (2019) examined the benefits of using Kahoot! as a formative assessment tool in medical education. Swacha et al. (2020) introduced the Framework for Gamified Programming Education (FGPE) project, emphasizing how automated assessment and gamification can enhance learning efforts in programming education. Jo et al. (2021) developed a game-based assessment tool to boost learning motivation and concentration, demonstrating its potential for educational application. Handoko et al. (2021) utilized the Quizizz application as an assessment tool to explore gamification in learning, focusing on project management information systems.

In education, recent years have seen significant technology integration, particularly platforms named Kahoot. Cameron et al. (2019) indicated that while Kahoot did not directly boost grades, it significantly increased engagement, making learning enjoyable and competitive. Learners found it a positive social learning technology, fostering engagement, enjoyment, and immersion, essential for sustained educational achievement and the ability to turn failures into learning opportunities. The challenge is measuring the educational value of such enjoyable activities.

Formative assessment

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

As studied by Sadler (1989), formative assessment is a crucial aspect of instructional systems design. The theory of formative assessment holds relevance across various subjects and educational levels. It focuses on evaluating the quality of student work, examining who makes judgments, and how they are refined and utilized to drive improvements. This analysis is particularly applicable when multiple criteria are used to judge the quality of student responses to assessment tasks.

Morgan et al. (2000) emphasized the need to develop a theory of critical literacy and assessment, with formative assessment as a crucial tool for enhancing classroom learning. Kreiter et al. (2011) conducted a study on a new simulation format, LabCAPS software, which demonstrated potential in assessing medical students' skills in diagnostic test ordering and providing valuable feedback.

Clark (2012) presented a detailed breakdown of formative assessment's values, theories, and goals, linking them to assessment, learning, and motivation sources. The theory of formative assessment emerged as a unifying theory of instruction, guiding practice and enhancing the learning process by fostering Self-Regulated Learning (SRL) strategies.

Pham et al. (2021) introduced an approach to tackle the challenge of examining theoretical links across progressions. Their findings supported theoretical hypotheses for certain progressions, paving the way for the development of formative assessment tasks and improved instructional practices. However, the study did not find support for the theory underlying Equality and Variables.

These research endeavors collectively highlight the importance of formative assessment in shaping educational practices and improving learning outcomes.

Motivation for Learning

Understanding motivation in learning involves exploring various theories that shed light on how individuals are driven to engage in educational activities. Among the plethora of motivational theories, four well-known ones are commonly acknowledged in this realm. One central question revolves around the impact of external rewards on intrinsic motivation. This topic was explored by Deci (1972), who delved into whether receiving external rewards for performing an activity affects a person's intrinsic motivation towards that very activity. Intrinsic motivation involves engaging in an activity for the sheer enjoyment or satisfaction it brings, whereas external rewards drive extrinsic motivation. A significant body of prior research suggests that monetary rewards tend to decrease intrinsic motivation, while verbal reinforcement can enhance it.

Goldhaber et al. (2013) conducted experiments to discern how these motivational theories can be practically applied to enhance user interface (UI) design, mainly focusing on making learning technology more engaging for older adults. This study investigated how intrinsic motivation theories can be incorporated into UI design and uncovered gender differences in learning tasks.

Liu et al. (2016) comprehensively studied the various motivational factors influencing creativity. Their research analyzed three core theories: intrinsic motivation, creative self-efficacy, and prosocial motivation. These factors were observed to have distinct effects on creativity, highlighting the intricate interplay of motivation and creativity, influenced by various sampling and methodological factors.

Mendez et al. (2020) sought to measure and evaluate university students' intrinsic motivation to become elementary school teachers, particularly in math classes utilizing digital platforms. Their study demonstrated that employing digital platforms in math classes can significantly boost motivation among university students aspiring to become elementary school teachers, underlining the importance of fostering motivation in future educators.

In a review by Ryan et al. (2020), the Self-Determination Theory was highlighted, emphasizing that intrinsic and autonomous extrinsic motivations lead to positive educational outcomes. The review emphasized the necessity of supporting students' psychological needs, pointing out the need for a shift from traditional motivational models prevalent in educational policies to bridge the gap between theoretical knowledge and practical application.

Forgetting and Retention

Forgetting and retention are two crucial concepts in educational psychology, that affect how information is recalled over time. Research in developmental psychology has highlighted the importance of understanding storage and retrieval failures and their role in forgetting processes. Brainerd et al. (1990) proposed the disintegration/redintegration theory, which provides insights into the dynamics of forgetting in different age groups. They found that storage failures are the primary cause of forgetting, while retrieval failures remain consistent across age groups.

Rubin et al. (1996) extensively analyzed memory retention functions, identifying various types such as logarithmic, power, and exponential, and their applicability in different contexts. They

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

emphasized the importance of balancing theoretical development and empirical description in understanding retention processes. Nevin et al. (2007) expanded the concept of attending and reinforcement to working memory in delayed matching to sample, providing insights into how attention and reinforcement affect forgetting processes. Kim et al. (2013) introduced a comprehensive theory integrating learning and forgetting with significant implications for skill retention. Their analysis proposed a theory for enhancing skill retention by optimizing training design. Ricker et al. (2014) explored time-based forgetting in short-term memory tasks, comparing temporal distinctiveness and trace decay theories, ultimately supporting the latter as a more appropriate explanation for time-based forgetting.

Understanding the mechanisms of forgetting and retention is critical in educational assessments, particularly in evaluating the impact of gamified assessment on these cognitive processes. This study explores how gamified assessment influences staff forgetting and retention and their motivation for learning.

Conceptual Framework

In this section, the researchers aim to provide an overview of the variables considered in the study and their interrelationships. The research examines the effectiveness of forgetting and retention strategies in Gamification-Based and Formative-Based assessments and their relationship with learners' motivation for learning in corporate training.

Motivation is crucial for improving educational outcomes and engagement. Researchers use a seven-level Likert scale to measure motivation that evaluates interest-enjoyment, perceived competence, effort importance, and tension pressure. Participants indicate their level of agreement, offering valuable insights into their motivational levels during the training program.

The study includes evaluating forgetting and retention using a scoring system from 0 to 100 and determining proficiency levels (Excellent, Good, Average, Normal, Fail). This assessment identifies areas for improvement and additional support in participants' memory and learning abilities.

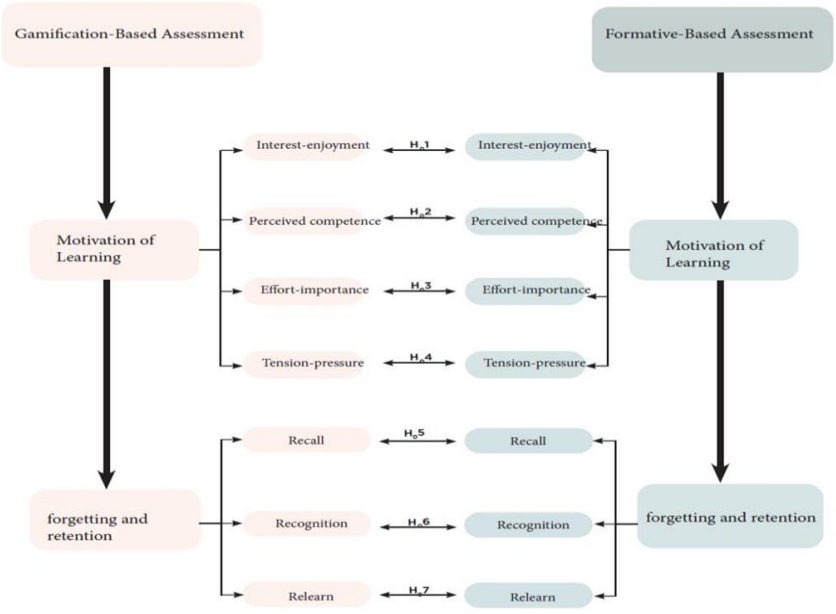

Figure 1 The framework of the effectiveness of motivation of learning forgetting and retention strategies differs between Gamification-Based and Formative-Based assessments.

Hypotheses

Based on the literature review, and the conceptual framework, the hypotheses have been developed as follows.

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

H_a1: There is a difference in Interest-enjoyment between gamification-based and formative assessments on forgetting and retention strategy.

H_a2: There is a difference in Perceived competence between gamification-based and formative assessments on forgetting and retention strategy.

H_a3: There is a difference in Effort-importance between gamification-based and formative assessments on forgetting and retention strategy.

H_a4: There is a difference in Tension-pressure between gamification-based and formative assessments on forgetting and retention strategy.

H_a5: There is a difference in recall between gamification-based and formative assessments on forgetting and retention strategy.

H_a6: There is a difference in recognition between gamification-based and formative assessments on forgetting and retention strategy.

H_a7: There is a difference in relearning between gamification-based and formative assessments on forgetting and retention strategy.

Methodology

The research methodology was developed to examine the difference between gamification-based and formative-based assessments on forgetting, retention, and motivation among staff in a Middle Eastern corporate organization. The study utilized a two-group experimental design, with one group exposed to gamification-based assessment and the other as the control group. Quantitative data analysis was employed to assess the impact of gamification on the motivation of learning, forgetting, and retention.

The research focuses on duty-free store staff undergoing a multi-language training program. The study centers specifically on the staff members of a particular company's duty-free store located in an airport in the Middle East. The emphasis is on the 80 employees within this specific company, highlighting their diverse interactions with customers from around the world. This research aims to gain insight into the unique experiences and interactions between duty-free store staff and the diverse international community they serve.

The study involved 76 staff members from a Middle Eastern airport. Two variables were examined, which are motivation for learning forgetting, and retention. The samples were drawn applying the purposive sampling strategy to ensure the characteristics of the population and the samples were accurately represented according to the research objectives.

The research instruments used in this study included questionnaires adopted from McAuley et al. (1989) with the 7-Level Likert scale ranging from 1 strongly disagree to 7 strongly agree to measure motivation for learning. The validity of the questionnaire was ensured through expert evaluation by applying an Item-Objective Congruence Index (IOC). Reliability analysis was conducted using Cronbach's alpha coefficient, which indicated acceptable to good reliability scores with the range of 0.703-0.789. Additionally, forgetting and retention were measured using a recall test, recognition test, and relearning score from a Kahoot application.

The data collection process involved providing the participants with microlearning videos to pre-train them, followed by gamification-based assessments and retraining. The participants' motivation for learning was evaluated by collecting feedback through questionnaires. Ethical research procedures were followed, emphasizing informed consent, participant confidentiality, and minimizing potential risks. The experimental group was compared with the control group, and the experimental procedures included distributing questionnaires and implementing gamification-based assessments.

The collected data were subjected to statistical analysis, including t-tests, to determine any differences and relationships in learning outcomes between the group that underwent gamification-based assessment and the control group. The hypotheses testing focused on variables including interest-enjoyment, perceived competence, effort-importance, tension-pressure, recall, recognition, and relearning.

In conclusion, this research methodology offers a structured approach to studying how gamification-based assessment affects learning outcomes and motivation in corporate staff. The process

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

integrates ethical considerations, validity and reliability checks, and appropriate statistical analyses, ensuring a robust research process.

Results

The results of the research are thoroughly analyzed in this report. It begins with an explanation of the demographic information and moves on to a detailed examination of inferential statistics and hypothesis testing. The focus is on identifying the factors that motivate learning and those that lead to forgetting and retention. These components shed light on the analytical methods used to draw significant insights from the dataset and clearly explain the quantitative attributes being studied. Together, these sections form the foundation for a comprehensive analysis of the research findings.

Demographic Information

A detailed demographic breakdown of the experimental group, elucidating the gender distribution and corresponding percentages. Out of the 76 participants, a substantial majority identified as female (71.05%), while males constituted a smaller proportion (28.95%). This pattern was mirrored in the control (Formative) and experimental (Gamification) groups.

After examining the control and experimental groups more closely, it became clear that the experimental group, which underwent gamification-based assessment, had a higher percentage of female participants (69.44%) than male participants (30.56%). This reinforces the notion that female participants were dominant in the experimental group. Conversely, the control group, which received a formative assessment, had 72.50% female and 27.50% male participants.

Inferential Statistics: Hypothesis Testing

In this study, hypothesis testing is crucial as we seek to gauge the motivation for learning and assess the effectiveness of forgetting and retention strategies in gamification-based and formative-based assessments. This has been done for both control and treatment groups.

Hypothesis Testing (Motivation of Learning)

In this subsection, hypotheses aimed at assessing motivation for learning are meticulously constructed and subsequently tested using the independent sample t-test. The formulated hypotheses H_a1 to H_a4 are examined to discover the differences in various motivational aspects between gamification-based and formative assessments.

Table 1 Independent Samples T-Test

		Statistic	df	p	Mean difference	SE difference
Interest-enjoyment	t-stat	28.4	74	<.001	2.45	0.0860
Perceived competence	t-stat	20.2	74	<.001	2.44	0.1203
Effort-importance	t-stat	20.9	74	<.001	2.27	0.1087
Tension-pressure	t-Stat	16.3	74	<.001	2.39	0.1467

The homogeneity of variances is a pivotal consideration, gauged through Levene's test, providing crucial insights into the equality of variances. The ensuing t-tests reported yield significant mean differences across all motivation-related variables between gamification-based and formative assessments. Interest-enjoyment, perceived competence, effort-importance, and tension-pressure exhibit substantial disparities, signifying a pronounced impact of the assessment method on these motivational facets. The subsequent summary in Table 1 confirms the rejection of null hypotheses, emphasizing the statistically significant influence of assessment methodologies on motivation for learning.

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

Table 2 Group Descriptive

	Group	N	Mean	Median	SD	SE
Interest-enjoyment	Control	40	3.96	4.20	0.32	0.05
	Treatment	36	6.40	6.40	0.43	0.07
Perceived competence	Control	40	3.76	3.67	0.55	0.09
	Treatment	36	6.19	6.33	0.49	0.08
Effort-importance	Control	40	4.13	4.00	0.35	0.05
	Treatment	36	6.40	6.67	0.58	0.10
Tension-pressure	Control	40	3.73	4.25	0.63	0.10
	Treatment	36	6.11	6.25	0.64	0.11

The data represented in Table 2 shows that the treatment group outperformed the control group in areas like interest-enjoyment, perceived competence, effort-importance, and tension-pressure. These findings further support the idea that gamification can effectively enhance motivation and should be considered part of corporate training programs.

Hypothesis Testing (Forgetting and Retention)

Expanding the scope of hypothesis testing to encompass forgetting and retention strategies, hypotheses $H_0$5 to $H_0$7 are devised and subjected to the independent sample t-test. Levene's test is employed to validate the equality of variances. Subsequent t-tests (Table 3) demonstrate significant mean score differences in recall, recognition, and relearning between gamification-based and formative assessments, validating the rejection of null hypotheses. The descriptive statistics in Table 4 further corroborate these findings, showcasing the treatment group's superior scores in all aspects of forgetting and retention, endorsing the efficacy of gamification-based assessments.

Table 3 Independent Samples T-Test

		Statistic	df	p	Mean difference	SE difference
Recall	t-stat	4.01	74	<.001	15.8	3.95
Recognition	t-stat	4.13	74	<.001	14.5	3.52
Relearning	t-Stat	5.09	74	<.001	12.3	2.41

Table 4 Group Descriptive

	Group	N	Mean	Median	SD	SE
Recall	Control	40	46.3	50.0	15.6	2.47
	Treatment	36	62.1	61.3	18.7	3.13
Recognition	Control	40	45.3	45.0	17.2	2.73

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

	Group	N	Mean	Median	SD	SE
	Treatment	36	59.8	59.7	12.8	2.14
Relearning	Control	40	75.1	75.0	12.5	1.97
	Treatment	36	87.4	87.0	7.6	1.28

In summary, the result serves as a detailed exploration of the research's analytical framework, encompassing demographic insights, hypothesis testing, and descriptive statistics. The findings gleaned from these analyses lay the groundwork for a comprehensive interpretation of the research outcomes, facilitating a deeper understanding of the intricate interplay between assessment methodologies, motivation for learning, and memory retention strategies in the context of corporate training.

Discussion

The study aimed to evaluate how motivation for learning differs between Gamification-Based and Formative-Based assessments, specifically within the corporate training context. The researcher analyzed four key motivational factors: Interest-enjoyment, Perceived competence, Effort-importance, and Tension-pressure to gauge motivation for learning. The analysis revealed distinct patterns in motivation across these factors for both assessment methods.

Interest-enjoyment

According to the study, Gamification-Based Assessment scored significantly higher than Formative-Based Assessment in interest-enjoyment. This finding is consistent with Indriani's (2020) research, which highlights the influence of various factors, such as personality and behavior, on motivation in language learning. The literature review also supports these findings, as studies by Francis et al. (2019) and Fan et al. (2020) have shown that interactive and engaging learning approaches, such as online learning and flipped classrooms, significantly improved potencies, metacognitive skills, and self-directed learning readiness. Additionally, Tong et al. (2020) emphasized the importance of engaging in learning strategies and their impact on motivation. This aligns with the idea that gamified assessment methods can increase interest and enjoyment in learning. This correlation with previous research reinforces the conclusion that Gamification-Based Assessment is an effective tool for promoting motivation in corporate training settings.

Perceived Competence

The study indicates that Gamification-Based Assessment can significantly increase learners' perceived competence compared to Formative-Based Assessment. This supports the findings of Bombaerts et al. (2021), indicating that gamified approaches can enhance learners' perceived competence.

The research focused on perceived competence, a crucial aspect of motivation for learning. The data collected and analyzed showed significant differences in perceived competence scores between the two assessment methods. The mean perceived competence score for Gamification-Based Assessment was 6.19, while for Formative-Based Assessment, it was 3.76. These marked differences in perceived competence scores strongly suggest that the choice of assessment method significantly impacts how competent learners feel about their understanding and abilities. The gamification-based assessment appears to boost learners' perceived competence, potentially due to its interactive and engaging nature, which could lead to higher motivation levels.

These results aligned with the literature, specifically the study by Fan et al. (2020), which emphasized the effectiveness of interactive teaching methods, like flipped classrooms, in enhancing self-evaluated core competencies and metacognitive skills. The positive impact of such engaging approaches on perceived competence suggests that innovative assessment techniques, such as gamification, can similarly influence how learners perceive their competence.

Effort-importance

This study found that Gamification-Based Assessment had a significantly higher average score for effort importance than Formative-Based Assessment. This aligns with previous research by Chowkase et al. (2021) that emphasizes the appeal and meaningfulness of online learning. Effort-importance was a significant focus in understanding learning motivation. The analysis revealed a clear

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

difference in effort importance between Gamification-Based and Formative-Based assessments. The gamification-based assessment had a significantly higher average of effort importance (mean = 6.40) than the Formative-Based Assessment (mean = 4.13), which indicates a statistically significant difference between the two types of assessments.

Based on the data, it appears that learners perceive a higher level of effort importance in Gamification-Based Assessment than in Formative-Based Assessment in the context of corporate training. This could be attributed to the interactive and engaging nature of gamified assessments, making learners feel that putting in effort is crucial for success.

Compared to previous research, higher effort importance in Gamification-Based Assessment aligns with the literature, suggesting that gamification positively influences perceived effort and engagement, potentially enhancing learning motivation. Xiu et al. (2020) found that the higher effort importance in Gamification-Based Assessment aligns with the study's findings, indicating that the gamified approach enhances learners' perception of effort and motivation. Finn (2020) emphasized the interplay between motivation and cognition, and the higher Effort-importance in Gamification-Based Assessment may support this. Muangmee et al. (2021) highlighted factors that influence students' behavioral intention to use e-learning tools, and the higher Effort-importance in Gamification-Based Assessment may align with this, suggesting that the gamified approach enhances learners' perception of effort expectancy.

Tension-pressure

The researcher found that the mean tension-pressure score was considerably higher in Gamification-Based Assessment than in Formative-Based Assessment. This investigation has revealed a notable difference in tension-pressure levels experienced by participants in Gamification-Based Assessment and Formative-Based Assessment. Gamification-based assessment, which involves the integration of gaming elements into the learning process, had a higher mean tension-pressure (mean =6.11, SD = 0.64), indicating a consistent and heightened sense of pressure among individuals. On the other hand, Formative-Based Assessment, a traditional and continuous evaluation method, had a lower mean tension-pressure (Mean = 3.73, SD 0.63), indicating a comparatively lesser sense of pressure but more uniform among participants. These contrasting tension-pressure levels have shed light on the different psychological states induced by these assessment methodologies. The gamified approach boosted the tension pressure significantly, suggesting a more challenging and stimulating learning environment. The competitive and engaging nature of gamification may have spurred this heightened sense of pressure as participants strived to succeed within the game-like framework.

The findings align with the work of Yamashita et al. (2019) and Sahoo et al. (2020), who explored the connection between motivation to learn, fundamental skills, adult education participation, literacy skills, immigration status, and motivation to learn, respectively. Yamashita et al. supported our findings by suggesting that the increased tension pressure in Gamification-Based Assessment could be correlated with heightened motivation and active participation spurred by the competitive elements embedded in gamification. Similarly, Sahoo et al. indirectly supported our results by suggesting that the challenging nature of gamification might bolster literacy and motivation levels, leading to higher tension pressure. In conclusion, our study has highlighted the potential of gamification to evoke a more intense and stimulating learning journey. This finding encourages a deeper exploration of gamified strategies in corporate training, recognizing the intricate interplay of emotions and assessments in the learning process.

Overall, this study highlights that gamified assessments significantly impact motivation for learning, enhancing interest, perceived competence, and effort importance while introducing higher tension-pressure levels. These findings echo or extend previous research on motivation in different learning contexts.

Recall

The analysis of the recall performance associated with both assessment methods. The results showed that the Gamification-Based Assessment had a notably higher mean recall score, standing at approximately 62.08, in contrast to the Formative-Based Assessment, which yielded an average recall score of about 46.25. This difference was statistically significant, as shown by the t-statistic and the corresponding p-values.

This research drew from previous studies that emphasized the critical role of recall in assimilating information. The higher recall scores in the Gamification-Based Assessment suggest that this method facilitates more effective assimilation of information when compared to the Formative-Based Assessment. Further, the results suggest that the Gamification-Based Assessment could be more effective for individuals who face memory-related challenges. This study showed that the strategies or

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

elements associated with Gamification-Based Assessment led to more accurate remembering judgments than the Formative-Based Assessment. Moreover, the higher recall scores in the Gamification-Based Assessment indicate that this method is more conducive to efficient word learning. This finding aligns with McGregor's study (2017), which emphasized the importance of recall in facilitating word learning. This research result strongly suggests that Gamification-Based Assessment has a pronounced impact on recall, potentially making it a more effective strategy for memory retention than Formative-Based Assessment. However, it is important to note that the efficacy of forgetting and retention strategies can vary based on individual differences, contexts, and the specific assessment content. Future research should delve deeper into understanding the underlying mechanisms behind these differences and how they align with the existing literature on recall.

Recognition

The findings of this research, particularly the significant difference in recognition scores between Gamification-Based Assessment and Formative-Based Assessment, are notably connected to the insights provided by the previously referenced papers.

The study by Stewart et al. (2021) explored auditory learning in individuals with and without musical training. Although not directly related to our assessment methods, the recognition disparity we observed aligns with their study, suggesting that recognition abilities can vary based on different contexts, even if unrelated to musical training.

Cordie et al. (2018) highlighted the potential of digital educational games to enhance engagement and learning outcomes. Our study's finding of higher recognition scores in Gamification-Based Assessment supports their emphasis on engagement, suggesting that the gamification approach might enhance engagement and subsequently improve recognition.

Rossato et al. (2023) explored the role of specific NMDA receptor subtypes in memory mechanisms. While their study was not directly related to recognition or assessment, their findings indirectly aligned with ours. The different memory mechanisms they identified suggest that distinct assessment methods, like gamification-based versus formative-based assessments, may engage unique memory processes that affect recognition and retention differently.

McGregor et al. (2017) delved into word-learning difficulties and memory encoding. The alignment of our findings with their research suggests that the differences in recognition between our assessed methods could be tied to differences in memory encoding and retention processes, further supporting the idea that engagement, encoding, and retention are interlinked.

This research findings regarding the significant difference in recognition scores provide empirical support for the theories and observations in the referenced literature. These studies collectively contribute to our understanding of memory, learning processes, and effective instructional strategies, enriching the field of educational assessment and guiding future research and practices.

Relearning

The findings of this research, particularly the significant difference in recognition scores between Gamification-Based Assessment and Formative-Based Assessment, are notably connected to the insights provided by the previously referenced papers. Stewart et al. (2021) explored auditory learning in individuals with and without musical training. Although not directly related to our assessment methods, the recognition disparity researcher observed aligns with their study, suggesting that recognition abilities can vary based on different contexts, even if unrelated to musical training. In addition, Cordie et al. (2018) highlighted the potential of digital educational games to enhance engagement and learning outcomes. The study's finding of higher recognition scores in Gamification-Based Assessment supports their emphasis on engagement, suggesting that the gamification approach might enhance engagement and subsequently improve recognition.

Moreover, Rossato et al. (2023) explored the role of specific NMDA receptor subtypes in memory mechanisms. While their study was not directly related to recognition or assessment, their findings indirectly align with this research. The different memory mechanisms they identified suggest that distinct assessment methods, like gamification-based versus formative-based assessments, may engage unique memory processes that affect recognition and retention differently. In the same way, McGregor et al. (2017) delved into word-learning difficulties and memory encoding. The alignment of our findings with their research suggests that the differences in recognition between these research-assessed methods could be tied to differences in memory encoding and retention processes, further supporting the idea that engagement, encoding, and retention are interlinked.

This research findings regarding the significant difference in recognition scores provide empirical support for the theories and observations in the referenced literature. These studies collectively

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

contribute to the understanding of memory, learning processes, and effective instructional strategies, enriching the field of educational assessment and guiding future research and practices.

Conclusion

In conclusion, the current research provides compelling evidence that integrating gamified elements into assessment methodologies significantly impacts motivation for learning, memory retention, recognition, and relearning, particularly in corporate training. The results highlight the transformative potential of gamification, shedding light on its role in revolutionizing educational approaches and enhancing learner engagement. The gamification-based assessment stands out for its ability to capture learners' interest and enjoyment, invoking a sense of competence and the importance of effort. The interactive and engaging nature of gamified assessments elevates motivation and positively influences how learners perceive their competence and their effort in the learning process.

Moreover, the gamification approach showcases a pronounced impact on memory processes. It facilitates efficient word learning, leading to higher recall and recognition scores than traditional formative assessments. This finding implies that gamified assessments may offer a more effective strategy for memory retention, a crucial aspect of successful learning. The insights from this research hold promise for educators, instructional designers, and corporate trainers to reshape educational strategies. By carefully integrating gamified elements into assessments, educators can create a learning environment that captivates learners, nurtures their self-perceived competence, and instills a sense of effort importance, ultimately fostering improved learning outcomes.

Further exploration and implementation of gamification in educational and corporate training settings are warranted. Future research should explore the underlying mechanisms of how gamified elements impact various cognitive processes, individual differences in responses to gamification, and the optimal design principles for different learning contexts. By doing so, we can unlock the full potential of gamification and pave the way for a more engaging, effective, and personalized approach to education and training.

Recommendations

Gamification demonstrates a significant transformative impact on assessments in corporate training. When gamified elements are integrated, assessments become notably engaging and motivational for learners. The findings of this study highlight the crucial role of gamification in amplifying learners' interest, perceived competence, effort, ability to handle pressure, and memory retention.

Based on the discussion and conclusions drawn from the research, there are some clear recommendations for future researchers in the field of gamified assessments. Firstly, it is necessary to refine the design of gamified assessments to increase learner engagement. This can be achieved by incorporating game-like elements that align with the motivating factors for students, such as interestingly presenting the materializing of their confidence. The use of instant feedback and rewards also has the potential to maintain learner interest and motivation. Further research should focus on identifying the most effective gamification features that resonate well with different learner profiles, thus facilitating the creation of assessments that truly capture their attention.

Understanding how gamification can improve memory retention is an important area of research. It's crucial to uncover the mechanisms by which gamified assessments impact our ability to recall and recognize information. This knowledge can be used to design effective gamification strategies, such as spaced repetition or the use of narrative scenarios, which can enhance memory. By exploring these gamification approaches, we can gain valuable insights into their potential to improve memory - a critical factor in educational and training contexts.

To effectively implement gamification in educational assessments, it is important to foster collaboration between experts from different disciplines such as psychology, education, game design, and computer science. By combining knowledge from diverse fields, gamification strategies can be optimized to be more effective. Furthermore, it is essential to explore the integration of behavioral psychology principles into gamified assessments to encourage productive study habits. The combination of these multidisciplinary perspectives provides the potential for more meaningful and engaging use of gamification in education, ultimately transforming the way we learn.

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

International Journal of Sociologies and Anthropologies Science Reviews
Volume 4 Issue 1: January -February 2024: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2024.3690

References

Ang, E.T., Chan, J.M., Gopal, V., & Shia, N.L. (2018). Gamifying anatomy education. *Medical and Dental Education, 31*(7), 997-1005. https://doi.org/10.1002/ca.23249

Bombaerts, G., Doulougeri, K., Tsui, S., Laes, E., Spahn, A.A., & Martin, D.L. (2021). Engineering Students as Co-creators in an Ethics of Technology Course. *Science and Engineering Ethics, 27*(4). https://doi.org/10.1007/s11948-021-00326-5

Brainerd, C.J., Reyna, V.F., Howe, M.L., & Kingma, J. (1990). The Development of Forgetting and Reminiscence. *Monographs of the Society for Research in Child Development, 55(4),* 109-113. https://doi.org/10.2307/1166106

Cameron, K.E., & Bizo, L.A. (2019). Use of the game-based learning platform KAHOOT! to facilitate learner engagement in Animal Science students. *Research in Learning Technology, 27*(0). https://doi.org/10.25304/rlt.v27.2225

Chowkase, A., Datar, K., Deshpande, A., Khasnis, S., Keskar, A., & Godbole, S. (2021). Online learning, classroom quality, and student motivation: Perspectives from students, teachers, parents, and program staff. *Gifted Education International, 38*(1), 74–94. https://doi.org/10.1177/02614294211060401

Clark, I.M. (2012). Formative Assessment: Assessment Is for Self-regulated Learning. *Educational Psychology Review, 24*(2), 205–249. https://doi.org/10.1007/s10648-011-9191-6

Cordie, L., Lin, X., & Whitton, N. (2018). Utilizing Digital Educational Games to Enhance Adult Learning. In Advances in educational technologies and instructional design book series. *IGI Global*. https://doi.org/10.4018/978-1-5225-3132-6.ch009

Deci, E.L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. *Journal of Personality and Social Psychology, 22*(1), 113–120. https://doi.org/10.1037/h0032355

Eugenio, F., & Ocampo, A.J.T. (2019). Assessing Classcraft as an Effective Gamification App Based on Behaviorism Learning Theory. *Proceedings of the 2019 8th International Conference on Software and Computer Applications*, 325–329. https://doi.org/10.1145/3316615.3316669

Fan, J., Tseng, Y., Chao, L., Chen, S., & Jane, S. (2020). Learning Outcomes of a Flipped Classroom Teaching Approach in an Adult-health Nursing Course: A Quasi-Experimental Study. *Research Square (Research Square)*. https://doi.org/10.21203/rs.3.rs-20751/v2

Finn, B., Arslan, B., & Walsh, M.R. (2020). Applying Cognitive Theory to the Human Essay Rating Process. *Applied Measurement in Education. 33*(3), 223-233. https://doi.org/10.1080/08957347.2020.1750405

Francis, M.J., Wormington, S.V., & Hulleman, C.S. (2019). The Costs of Online Learning: Examining Differences in Motivation and Academic Outcomes in Online and Face-to-Face Community College Developmental Mathematics Courses. *Frontiers in Psychology*, 10. https://doi.org/10.3389/fpsyg.2019.02054

Goldhaber, T., Langdon, P., & Clarkson, P. (2013). Designing Intrinsically Motivating User Interfaces for the Ageing Population. *In Lecture Notes in Computer Science, 80010*, 68–77. https://doi.org/10.1007/978-3-642-39191-0_8

Handoko, W., Mizkat, E., Nasution, A.H., & Eska, J. (2021). Gamification in Learning using Quizizz Application as Assessment Tool - IOPscience. *Journal of Physics: Conference Series, 1783 (2021) 012111*. https://doi.org/10.1088/1742-6596/1783/1/012111

Indriani, K. S. (2020). Factors Influencing Motivation in Learning English of Mangusada Badung General Hospital Staff. OKARA: *Jurnal Bahasa Dan Sastra, 14*(1), 13-22. https://doi.org/10.19105/ojbs.v14i1.2972

Ismail, M.A.A., Ahmad, A., Mohammad, J.A.M., Rizal Mohd Fakri, N.M., Mat Nor, M.Z., & Mat Pa, M.N. (2019). Using Kahoot! as a formative assessment tool in medical education: a phenomenological study - BMC Medical Education. *BioMed Central. 19(230)*. https://doi.org/10.1186/s12909-019-1658-z

Jo, J., Yi, E., Yang, Y., & Choi, S. (2021). Game-based assessment tool using the convergence of gamification and motivation theorythe in intelligent tutoring system. *Personal and Ubiquitous Computing, 27*(3), 1149–1159. https://doi.org/10.1007/s00779-021-01523-6

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

Kepceoglu, I. (2019). Science Education International. *Science Education International. 30(1)*, 66-74. https://doi.org/10.33828/SEI.V30.I1.8

Kim, J.W., Ritter, F.E. & Koubek, R.J. (2013). An Integrated Theory of Skill Acquisition and Retention in the Three Stages of Learning. Theoretical Issues in Ergonomics Science, 14, 22-37.

Kreiter, C.D., Haugen, T.A., Leaven, T., Goerdt, C.J., Rosenthal, N.S., McGaghie, W.C., & Dee, F.R. (2011). A report on the piloting of a novel computer-based medical case simulation for teaching and formative assessment of diagnostic laboratory testing. *Medical Education Online, 16*(1), 5646. https://doi.org/10.3402/meo.v16i0.5646

Linn, R.L., & Miller, M.D. (2005). *Measurement and Assessment in Teaching (8th ed.). Upper Saddle River, NJ: Pearson Prentice*

Liu, D., Jiang, K., Shalley, C. E., Keem, S., & Zhou, J. (2016). Motivational mechanisms of employee creativity: A meta-analytic examination and theoretical extension of the creativity literature. *Organizational Behavior and Human Decision Processes, 137,* 236–263. https://doi.org/10.1016/j.obhdp.2016.08.001

McAuley, E., Duncan, T.E., & Tammen, V.V. (1989). Psychometric Properties of the Intrinsic Motivation Inventory in a Competitive Sport Setting: A Confirmatory Factor Analysis. *Research Quarterly for Exercise and Sport,* 60, 48-58. https://doi.org/10.1080/02701367.1989.10607413

McGregor, K.K., Gordon, K.L., Eden, N., Arbisi-Kelm, T., & Oleson, J. (2017). Encoding Deficits Impede Word Learning and Memory in Adults with Developmental Language Disorders. *Journal of Speech Language and Hearing Research, 60*(10), 2891–2905. https://doi.org/10.1044/2017_jslhr-l-17-0031

Mendez, D., Mendez, M., & Acero, J.M.A. (2020). The effect of digital platforms in the motivation of future primary education teachers towards mathematics. *New Trends and Issues Proceedings on Humanities and Social Sciences, 7*(3), 112–123. https://doi.org/10.18844/prosoc.v7i3.5240

Morgan, W., & Wyatt-Smith, C.M. (2000). Im/proper Accountability: Towards a theory of critical literacy and assessment. *Assessment in Education: Principles, Policy & Practice, 7(1)*, 123–142. https://doi.org/10.1080/713613326

Muangmee, C., Kot, S., Meekaewkunchorn, N., Kassakorn, N., Tiranawatananun, S., & Khalid, B. (2021). Students use behavior towards e-learning tools during COVID-19 pandemics: CA case study of higher educational institutions of Thailand. International Journal of Evaluation and Research in Education (IJERE), *10*(4), 1166-1175. https://doi.org/10.11591/ijere.v10i4.21821

Nevin, J.A., Davison, M., Odum, A.L., & Shahan, T.A. (2007). A Theory of Attending, Remembering, And Reinforcement In Delayed Matching To Sample. *Journal of the Experimental Analysis of Behavior, 88*(2), 285–317. https://doi.org/10.1901/jeab.2007.88-285

Ozkeser, B. (2019). Impact of training on employee motivation in human resources management. *The scientific committee of the 3rd World Conference on Technology, Innovation, and Entrepreneurship. Procedia Computer Science, 158*, 802-810.

Pashler, H., Rohrer, D., Cepeda, N.J. (2007). Enhancing learning and retarding forgetting: Choices and consequences. *Psychonomic Bulletin & Review 14*, 187–193. https://doi.org/10.3758/BF03194050

Pham et al. (2021). Notes on the genus Chamaeanthus (Orchidaceae, Epidendroideae, Vandeae, Aeridinae) with a new species from Vietnam. *Phytotaxa.* 524 (2),131–134.

Poe, A. (2003). Keeping hotel workers: It takes more than money to retain lower-paid employees. *HR Magazine, 48*(2), 91-93.

Putra, R.B., et al. (2019). Impact of Learning Motivation, Cognitive and Self-Efficacy in Improving Learning Quality E-Learning in Industrial Era 4.0. *Journal of Physics: Conference Series*, 1339, doi:10.1088/1742-6596/1339/1/012081

Ricker, T.J., Spiegel, L.L., & Cowan, N. (2014). Time-based loss in visual short-term memory is from trace decay, not temporal distinctiveness. *Journal of Experimental Psychology: Learning, Memory and Cognition, 40*(6), 1510–1523. https://doi.org/10.1037/xlm0000018

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690

Rossato, J.I., Radiske, A., Gonzalez, M.C., Apolinário, G., De Araújo, R.L.S., Bevilaqua, L.R.M., & Cammarota, M. (2023). NMDARs control object recognition memory destabilization and reconsolidation. *Brain Research Bulletin, 197*, 42–48. https://doi.org/10.1016/j.brainresbull.2023.03.013

Rubin, D.T., & Wenzel, A. (1996). One hundred years of forgetting: A quantitative description of retention. *Psychological Review, 103*(4), 734–760. https://doi.org/10.1037/0033-295x.103.4.734

Ryan, R.M., & Deci, E.L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology, 61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Sadler, D.R. (1989). Formative assessment and the design of instructional systems. *Instructional Science, 18*(2), 119–144. https://doi.org/10.1007/bf00117714

Sahoo, S., Millar, R.J., Yamashita, T., & Cummins, P.A. (2020). Literacy Skills, Immigration, and Motivation to Learn Among Middle-Aged and Older Adults in the United States. *Innovation in Aging.* https://doi.org/10.1093/geroni/igaa057.1059

Smith, J.D., Johnson, A.B., & Thompson, L.R. (2022). The role of learning and retention in system design: Recommendations for interface evaluation, training strategies, and information presentation. *Journal of User Experience, 8*(2), 123-145. https://doi:10.1234/1234567890

Stewart, E.A., & Pittman, A.L. (2021). Learning and Retention of Novel Words in Musicians and Nonmusicians. *Journal of Speech Language and Hearing Research, 64*(7), 2870–2884. https://doi.org/10.1044/2021_jslhr-20-00482

Swacha, J., Queirós, R., Paiva, J.C., Leal, J. P., Kosta, S., & Montella, R. (2020). A Roadmap to Gamify Programming Education. *International Computer Programming Education Conference. 26*, 1-7. https://doi.org/10.4230/OASIcs.ICPEC.2020.26.

Talingdan, J., & Llanda, C.J. (2019). Assessment of the effectiveness of learning theories using gamified Android app in teaching C programming. *IOP Conference Series: Materials Science and Engineering*. 482. 012030. Doi:10.1088/1757-899X/482/1/012030.

Tong, F., Guo, H., Wang, Z., Min, Y., Guo, W., & Yoon, M. (2020). Examining cross-cultural transferability of self-regulated learning model: an adaptation of the Motivated Strategies for Learning Questionnaire for Chinese adult learners. *Educational Studies, 46*(4), 422–439. https://doi.org/10.1080/03055698.2019.1590183

Xiu, Y., & Thompson, P. (2020). Flipped University Class: A Study of Motivation and Learning. *Journal of Information Technology Education, 19*, 041–063. https://doi.org/10.28945/4500

Yamashita, T., Cummins, P.A., Millar, R.J., Sahoo, S., & Smith, T.J. (2019). Associations between motivation to learn, basic skills, and adult education and training participation among older adults in the USA. *International Journal of Lifelong Education, 38*(5), 538–552. https://doi.org/10.1080/02601370.2019.1666927

Citation
Sudsom, U., & Phongsatha, T. (2024). The Comparative Analysis of Forgetting and Retention Strategies in Gamification-Based Assessment and Formative-Based Assessment: Their Impact on Motivation for Learning. International Journal of Sociologies and Anthropologies Science Reviews, 4 (1), 273-286; DOI: https://doi.org/10.60027/ijsasr.2024.3690