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EFL learners' motivation in a gamified formative assessment: The case of Quizizz

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Abstract

Over the past few years, the world's attention has been focused on gaming systems and their application in education through gamification, incorporating game features into learning tools. Against this backdrop, this study aims to investigate the motivation of EFL learners in a Gamified Formative Assessment (GFA). Theoretical insights from self-determination theory (SDT) are synthesized in the context of motivation analysis and internalization. Data from interviews and questionnaires are collected, and pair-t-tests and basic linear regression, CiteSpace, are utilized for data evaluation and literature review. Paired t-tests for the control group (CG) and the experimental group (EG) in the first and second stages, as well as the EG's first and second stages, show a strong positive correlation between CG's scores in stages one and two and EG's scores in both stages ($r1 = 0.930$, $r2 = 0.851$, $r3 = 0.953$, $p < 0.001$). It is found that Quizizz, as an example of GFA, can enhance EFL learners' internalization at a higher level during their learning process. Furthermore, our findings also suggest that gamification enables most EFL learners to recognize the value and benefits of assessment as motivation for identified regulation. Additionally, the overall accuracy of the students in the EG, which is 89.05%, is higher compared to the CG's accuracy of 74.01%. It is interesting to note that their motivation level correlates with their performance and engagement. With these findings, we contribute to the literature by validating that gamified formative assessment fosters the internalization of EFL at the elementary level, thereby enhancing students' engagement and language proficiency. Therefore, as one of the studies on gamification and motivation, this research holds unique value in analyzing EFL instruction at the primary school level.

Keywords SDT · Motivation · Gamified assessment · EFL · Formative assessment

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1 Introduction

Language can be considered a form of knowledge, but mastering it requires developing specific abilities. Those who solely focus on teaching language knowledge, such as in exam-oriented education, will never fully acquire this ability (Amoah & Yeboah, 2021; Namaziandost et al., 2019). Gamification has the power to evoke fundamental yet essential human emotions, such as a sense of accomplishment and excitement, which can bring joy and happiness to learners (Yassin & Abdulgalil Abugohar, 2022; Nuri et al., 2022; Mudure-Iacob, 2021). Furthermore, gamification not only facilitates emotional happiness but also plays a crucial role in helping learners acquire new skills and retain course content (Li et al., 2022; Kiyançiçek & Levent, 2022). One critical aspect of English teaching is the warm-up game, which significantly influences the atmosphere and effectiveness of an English class (Lohitharajah & Youhasan, 2022). To provide an overview of the discussions on gamification in education and teaching in the past decade, we employed CiteSpace, as illustrated in Fig. 1.

In Fig. 1, keywords such as game design, game elements, self-determination theory (SDT), student participation, and academic performance are highly cited in relation to "gamification". This indicates the increasing popularity of using gamification to analyze student behavior from the perspective of participation and ability. Many successful gamification studies have focused on the utilization of internal and external motives (Alsawaier, 2018; Buckley & Doyle, 2016; Deterding, 2012; Sailer & Homner, 2020). Other studies (Brigham, 2015; da Rochaa et al., 2016; Looyestyn et al., 2017; Xi & Hamari, 2020) have demonstrated that gamified language teaching can enhance student engagement in the classroom. By incorporating friendly competitions, challenges, and incentives, formative gamification assessment helps make exams more interesting, thereby effectively improving students' participation in English learning.

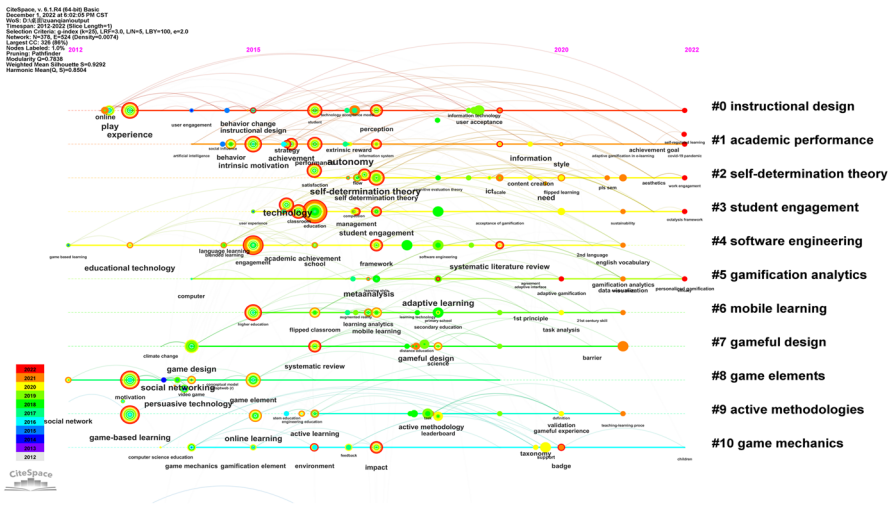


Fig. 1 Gamification in Education Research's Keywords in 2012–2022. *Note*: Data Collected from World of Science and Visualized in CiteSpace

Games are among children's favorite activities, especially for primary school students. Introducing games into the classroom can transform mundane language phenomena into lively and engaging teaching methods that students are eager to embrace (Vrcelj et al., 2023). Consequently, students' future English learning and teaching practice will be influenced to varying degrees by the internal and external motivation fostered through gamified formative assessment. Of course, it is crucial to provide EFL learners with an opportunity to test their knowledge before conducting a comprehensive evaluation. As one of the online formative assessment tools, Quizizz is widely recognized by scholars as a means to enhance students' learning outcomes (Yam & Rossini, 2013; Zhorova et al., 2022; Nicol & Macfarlane-Dick, 2006; Denton et al., 2008).

Currently, there is a lack of comprehensive research on EFL in primary education, with most studies focusing on higher education. While the motivation of self-determination theory and the instructional effects of gamification in education have been established, the relationship between learning English as a second language (LESL) and gamification has received less attention. Most studies in LESL have explored how the gamified classroom environment impacts language abilities, such as oral proficiency (Alvia González, 2022; Muthukumar & Neelakandan, 2019), but the connection between gamification and LESL motivation remains understudied. Moreover, many teachers and students utilize formative assessment to enhance the learning process and outcomes (Black & Wiliam, 1998; Bennett, 2011; Boston, 2002; Cowie & Bell, 1999), highlighting the reliability of this approach.

Therefore, this paper adopts the perspective that gamification in education enhances student motivation (Buckley & Doyle, 2016; Campillo-Ferrer et al., 2020; Chapman & Rich, 2018) and explores the impact of gamified formative assessment on English learning, specifically investigating its influence on primary school students' Basic Interpersonal Communicative Skills (BICS). Unlike previous research that primarily focused on categorizing game elements and evaluating the effectiveness of game design elements (Chan et al., 2018; Ibrahim & Jaafar, 2009; Wee & Choong, 2019), this paper primarily examines whether gamified formative assessment promotes students' internalization. The experimental design compares the gamified evaluation with the non-gamified assessment in both the control group and the experimental group. Interviews and questionnaires are employed to monitor changes in students' motivations. Additionally, detailed information regarding the accuracy and completion of students' formative assessments will be provided, offering new insights into English teaching.

2 Literature review

2.1 Research status of EFL learners' motivation

EFL refers to English as a Foreign Language course. The characteristics of EFL include a lack of exposure to the target language environment and limited opportunities for language use (Oviedo & Charpentier, 2023). As EFL learners primarily focus on daily communication, they tend to learn standardized expressions and usage, rather than subject knowledge in English like native speakers. This often

leads to low motivation among students. Gamlo (2019) investigated the impact of integrating language learning applications based on mobile games on the English learning motivation of Saudi female EFL students. He discussed students' perspectives on the teaching value of various free language learning games, including "game books," "great readers," "English learning games-English tracker," and "popular test for learning English vocabulary." The results demonstrated that EFL students were motivated to learn English. Students believed that these applications were beneficial for learning and improving their English learning motivation. These findings contribute to the study of mobile game-based learning and EFL students' motivation. Pishghadam et al. (2021) explored whether teachers' positive teaching behaviors could predict teaching effectiveness through the mediation of students' active and passive motivation. They found that teachers' positive interpersonal communication behaviors, as examples of good teaching behavior, increased students' enthusiasm for foreign language learning and subsequently improved their understanding of English teachers' professional success.

Kopinska and Azkarai (2020) investigated the potential changes in motivation among 64 young learners of Spanish as a Foreign Language who completed various dictionary tasks individually and in pairs over the course of a school year. The results indicated that over time, English learning motivation became more stable, while anxiety levels decreased. Safdari (2021) examined the effectiveness of a vision-based motivational intervention program in enhancing the motivational attributes of Iranian EFL learners. The study adopted the L2 motivational self-system, introducing concepts such as possible self, vision, and image, which stimulated learners' motivation and yielded positive results. Namaziandost et al. (2022) discussed the influence of using authentic materials on EFL learners' reading comprehension, reading motivation, and reading anxiety. The study revealed that the use of authentic texts significantly reduced anxiety among EFL learners in the experimental group.

These studies collectively highlight the importance of adjusting teaching environments, methods, and content to enhance EFL learners' motivation for language learning. Gamification and enjoyable evaluation methods can improve the overall classroom atmosphere and help students develop stronger learning motivation, which holds significant value for EFL learners. However, there is still a limited number of research studies in this field, and the relationship between gamified formative assessment and EFL learning motivation has yet to be fully explored. Therefore, this paper aims to bridge this gap in knowledge.

2.2 Gamification and gamified-assessment tools

Gamified learning environments, from an educational perspective, improve learning and teaching by increasing levels of engagement and motivation (Bitonto et al., 2014). According to Deterding et al. (2011), gamification integrates game concepts into non-game settings to enhance users' motivation and engagement. Points, badges, leaderboards, and storylines are classic examples of gamification elements that create game-like experiences (See et al., 2022). As we entered the twenty-first

century, gamification of learning gained popularity as academics and educators recognized its potential applications. Huang and Soman (citation needed) argue that gamification impacts motivation, which, in turn, helps individuals acquire greater competence and information.

Analyzing the research literature reveals that gamified assessment enhances learning. Assessment allows instructors to systematically gather data on students' learning progress (Linn & Miller, 2005). It differentiates between the summative and formative functions within program assessment (Black & Wiliam, 2003; Wiliam & Thompson, 2008). According to Scriven (citation needed), formative evaluation, unlike overall summative evaluation, aims to facilitate an individual's progress. Nonverbal feedback, homework assignments, and question-and-answer sessions are typical examples of formative assessment. A novel evaluation technique that incorporates gaming elements into students' work is known as "game-based assessment" (Song & Sparks, 2019). It helps learners become more engaged and provides them with a positive learning experience in a relaxed environment (Attali & Arieli-Attali, 2015; Georgiou et al., 2019; Menezes & De Bortolli, 2016). According to Gardner and Gardner (2012), games can be used to support the learning process during the assessment phase of language instruction. Gamified assessment allows students to learn from their mistakes in a fun setting and make inductive corrections (Wood et al., 2013).

With the assistance of the well-known assessment gamification platform Quizizz, teachers can conduct enjoyable and engaging student-paced formative tests with students of all ages. In Fig. 2, we examine the game features in Quizizz based on the gamification factors outlined by Werbach and Hunter (2012). The smallest elements directly influencing gamification design are referred to as components. The gamified environment, which includes advancement, emotion, and relationships, is characterized by game dynamics. The mechanic's process involves crucial procedures to elicit behavior and increase player engagement (Werbach & Hunter, 2012).

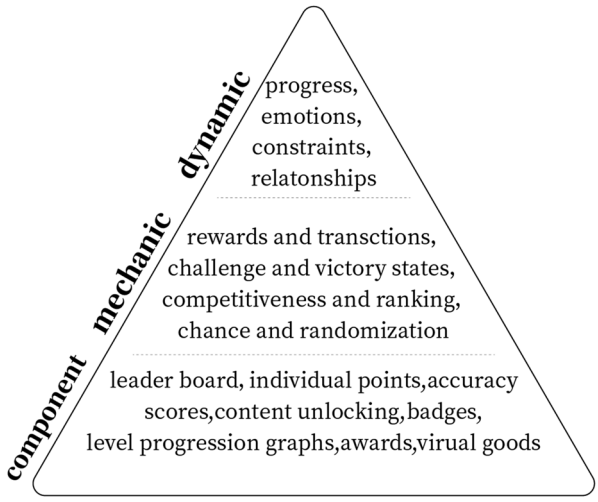


Fig. 2 Quizizz gamified elements from dynamic, mechanics, components

2.3 Self-determination theory (SDT)

Self-Determination Theory (SDT) could be used as a theoretical framework to incorporate problems with online education. The well-known theory of motivation distinguishes between internal and extrinsic motivation, which may be influenced by various rewards. (Ryan & Deci, 2017). An explanation of the dynamics of human need, motivation, and well-being in a social environment is the goal of this macro-level theory of human motivation. One of the mini theories of SDT, called Cognitive Evaluation Theory (CET), holds that all people have three psychological needs that drive them to act or not act: autonomy, competence, and relatedness. For each term, autonomy is defined as having a sense of control and voluntarily approving one's conduct. For instance, students demonstrate autonomy when prepared to invest the time and effort necessary to complete the evaluation independently.

Self-determination theory places a strong emphasis on how important the social environment is, which is consistent with the current trend of motivation. Competence is the sensation of mastery and feeling successful. When students believe they can achieve high marks on formative assessments, they are competent. Relatedness describes the desire to feel associated with and loved by people (Ryan & Deci, 2017). When students believe they may be connected by others like teachers, parents, or peers through the exam, they are related. So, when these three requirements are addressed, people feel more content and at peace with themselves; yet, when these needs aren't met, people become more fragmented, lonely, and receptive.

Researchers may also look at how context-specific elements, such as instructors' behavior, influence or detract from students' motivation using the SDT. Extrinsic motivation, as opposed to intrinsic drive, depends on the availability of outside forces for the action to occur, such as prizes, grades, or deadlines to promote the behavior (Deci & Ryan, 1985). *Extrinsic motivation* is broken down into four different categories by SDT, each with a different level of perceived autonomy. External regulation, introjected regulation, identifiable regulation, and integrated regulation are among the regulation processes (Ryan & Deci, 2000). *External regulation* is the least autonomous form of extrinsic incentive. For instance, pupils finish the test to get a prize or avoid trouble. During the exam, students wouldn't review or acquire the necessary information. The next kind of extrinsic motivation is *introjected regulation* when a person partially internalizes an extrinsic value but does not embrace the external value as their own (Deci et al., 1994). When they nevertheless obtain respectable grades due to chance or the system, students could feel awful or guilty. Finding value in the actions, which are more internalized external values, is the *identified regulation*. For instance, a student could prepare for a test because he values the opportunity tests give him to improve his knowledge. *Integrated regulation*, or the process by which an individual incorporates external values into his or her value system, is the most autonomous kind of extrinsic incentive (Deci & Ryan, 1985). For instance, a former pupil who valued tests will assist other students who are receiving bad results in keeping with his morals and interests.

To examine how gamified evaluation affects motivation, it is required to combine motivational theories with gamified activities. Deci and Ryan separate motivational states into three categories: intrinsic motivation, extrinsic motivation, and

amotivation (Deci and Ryan 2004). Figure 3 illustrates how intrinsic and extrinsic motivation is two parts, with intrinsic rules on one side and external regulations on the other, respectively. According to SDT, those who are extrinsically driven must internalize these rules and make them a part of who they are (Deci and Ryan 2004). Extrinsic rules will more frequently reflect the traits of intrinsic motivation as the internalization process progresses, placing intrinsic motivation in higher order. The study's external element, combined with Quzizz as the formative gamified evaluation, determines whether the internalization of learning is promoted. What stages of intrinsic and extrinsic motivation would learners reach if internalization occurs after applying the Quizizz.

3 Methodology

This paper tries to demonstrate the significant influence that a well-designed gamified evaluation has on EFL learners' motivation. It demonstrates specifically how Quizizz, within the framework of SDT, encourages young pupils to acquire English as a second language, potentially having a favorable impact on trainees' engagement and performance. The Research Questions are organized in accordance with this goal as follows:

RQ1: Will using Quizizz's gamified assessment help EFL learners internalize their motivation?
RQ2: Which level of extrinsic motivation will the EFL learners achieve with the help of the gamified assessment according to the Self Determination Theory (SDT)?
RQ3: Does the gamified assessment promote EFL learners' intrinsic motivation according to the Self Determination Theory (SDT)?
RQ4: If learners occur intrinsic motivation, to what extent do the EFL learners achieve autonomy, competency, and relatedness?

3.1 Participants

Participants were Forty-five EFL students from Elementary schools in China participated in this study. All participants in the study were between the ages of 8 and 10 (average age = 9.40, SD = 0.62), including 25 girls (55.56%) and 20

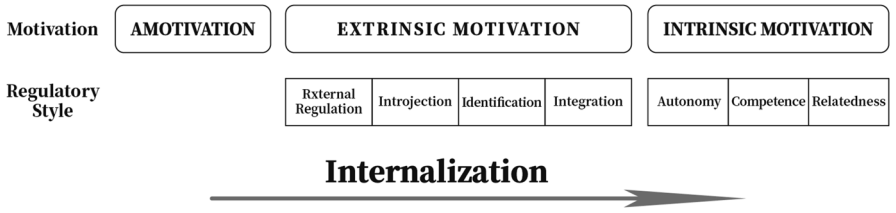


Fig. 3 Self-determination theory's taxonomy of motivation

boys (44.44%). As a pre-test for their language skills, 62 initial students voluntarily recruited from the internet through social media completed the Oxford Online English Test (2022), which had 40 multiple-choice questions. The website classified 45 participants as having English proficiency at the A2 (Pre-intermediate) level, which confirmed their close homogeneity. Other 17 pupils with accuracy levels below 35% at A1 (Elementary) and over 60% at B1 (Intermediate) were not included in the research. The selected participants were randomly divided into the control group with 22 students (female: 12 and male: 10) and the experiment group with 23 students (female:13 and male: 10). The experiment group of students received guidance on how to complete and use Quizizz on mobile technology such as phones and tablets.

All participants involved in the study and their social guidance were told of the study's contents and procedure. And proper authorization was obtained. All data were gathered anonymously with their social guidance's consent. Private information like the participants' true identities won't be revealed in the study.

3.2 Instruments

The undertaken study was conducted using a quantitative and qualitative approach. The quantitative instrument includes the pre-questionnaire and post-questionnaire as The Satisfaction Questionnaire for formative assessment, and interviews were used to assess the students' basic psychological needs and motivation and data collection of their performance in the Quizizz.

The pre-questionnaire used Five Likert scales ranging from strongly like, like, neutral, dislike, and strongly dislike. The pre-questionnaire includes students' motivation toward common vocabulary formative assessments like dictation, picture matching, translation, filling the sentence in the multiple-choice, and similar words pair. To ensure that students comprehend the questions on the questionnaire and accurately reflect their motivations. The questionnaire is made in Chinese, their first language and the facial expression is made for each degree of the choice. Examples of formative assessments are also shown in the questionnaire. The part of the sample is shown below in Fig. 4. The post-questionnaires are designed to measure students' motivation towards the form of the formative assessment given to the control group and the experimental group. It also includes the Five Likert scales with pictures and close questions in Chinese. And we show learners' responses as strongly agree/ agree/ neutral/ disagree/ strongly disagree as five to one.

The interview comprises open-ended questions on the interviewees' goals and attitudes toward language learning, formative assessment, and other topics. Their responses will be divided into three main groups, amotivation, extrinsic motivation, and intrinsic motivation, based on their responses. More detailed classification will be made under extrinsic motivation, like external regulation, and competence under intrinsic motivation. For example, students' responses like I do the work just because my parents asked me to complete will be categorized into

Fig. 4 Pre-questionnaire sample question. *Note*: This is the original version in Chinese

external regulation. By weighting each subscale and adding the weighted values, the Relative Autonomy Index (RAI; Connell & Ryan, 1984) is used. This single index applied the following results: amotivation −2, external regulation −1, introjected regulation 0, identifiable regulation +1, integrated regulation +2, and internal regulation +3.

The Quizizz platform offers details on each formative evaluation. It contains information about students' attendance, accuracy, points and scores, number of attempts, amount of time required, and incorrect questions. Parents of students upload their performance in the formative assessment's PDF format on social media. It includes the amount of time spent, the completion of the task, correctness, and incorrect questions, but it excludes gamified points. Students are given an equal opportunity of redoing the assessment.

3.3 Material

According to Vygotsky's central developmental construct of the zone of proximal development (ZPD) and Krashen's well-known construct of i + 1 (Vygotsky, 2012; Krashen, 1994), the study chooses the teaching and learning material within the child's potential development but little beyond our current level of competence. Hence, THINK Starter from Cambridge University Press with a CEF level of A1 is chosen for students. The formative assessment questions were all created based on what students learned each week from the THINK material, which includes the unit's target vocabulary.

3.4 Procedure

This study took place over the course of 20 weeks, starting in May 2022, as shown in Fig. 5. All of the chosen students had five minutes to answer the five questions on the pre-questionnaire. In-depth information regarding students' prior experiences, motivation for formative assessment, and attitudes toward language learning were also obtained through the interviews. The first stage of the learning and teaching process took place in the first ten weeks, while both the control group and the experimental group were taught the same

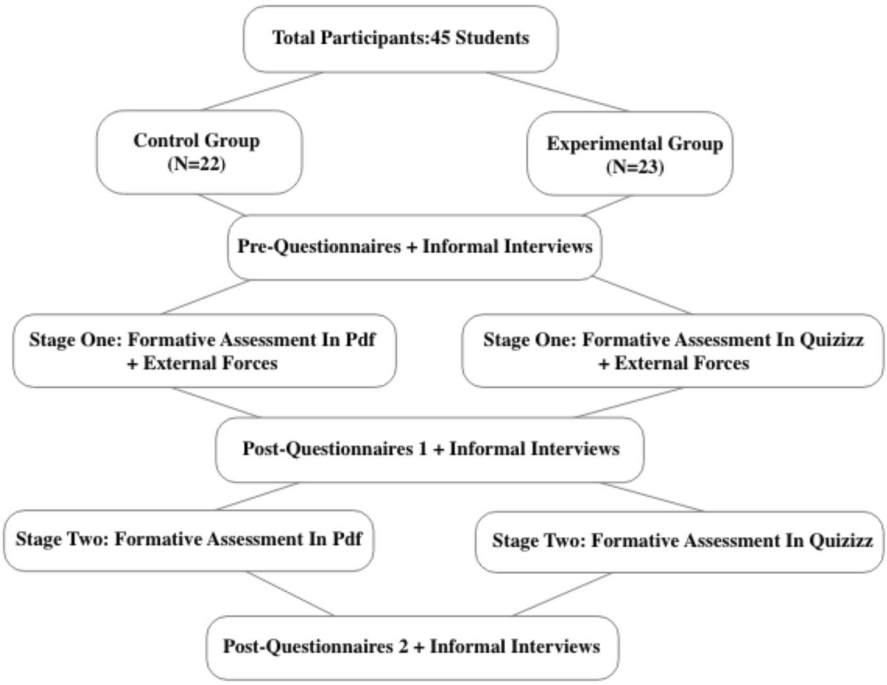


Fig. 5 Experimental process flow chart

content online once a week for 60 minutes. Each week after class, students will receive the formative assessment. The experimental group will answer the same questions in Quizizz, whereas the questions for the control group will be in PDF format. In the first step, both groups were informed of the same assignment deadline and awards that would be given out following the completion of the evaluation five times, with an accuracy rate of over 90%. In addition, the teacher will praise the pupils who do the assignment in class; the same steps are followed by both groups. All students will respond to post-questionnaires about their preference for the prior assignments they completed after ten exams. Additionally, they will be questioned regarding the purpose and viewpoints behind the assessment.

The second stage also lasts for ten weeks and follows a similar pattern of instruction and learning as the previous stage did. There will, however, be no additional incentives or deadlines for this round. Furthermore, the teacher will not bring up the outcome of the assessment in class. The tests are provided to students after class and are not required to be finished. The same post-questionnaire and interviews are given to verify the validity. Additional informal interviews will be conducted with some students' parents to gather more information regarding their performance outside of class and on tests.

4 Results and discussion

The purpose of the study is to explore the different types and transformations of EFL learners' internal and external motivation under SDT. There were two inductive and deductive steps in the analytical plan. Analyzing the data gathered from questionnaires and interviews helps the analytical induction explain how learners' motivation develops during the process. The three basic demands, the learners' motivation as determined by the informal interviews, and the production of a final list of classes and subcategories were used in the analytical deduction, which also employs the SDT principles.

4.1 Reliability

The results of the Kaiser-Meyer-Oklin (KMO) test in SPSS Statistics, which was used to verify the questions' adequate sampling, such as results in Table 1. The KMO value in this study was more than 0.7, indicating that factor analysis was suitable for the data. (Brown, 1993), and By assessing each variable's skewness and kurtosis, normality was checked for the post-questionnaires. The significance of the post-questionnaires is higher than 0.5%, which indicated that it follows a normal distribution in Table 2.

The triangulation method will be used in data analysis to ensure the validity and reliability of the study. The informal interviews will be used to confirm the

Table 1 Kaiser-Meyer-Oklin (KMO) for post and prequestionnaires

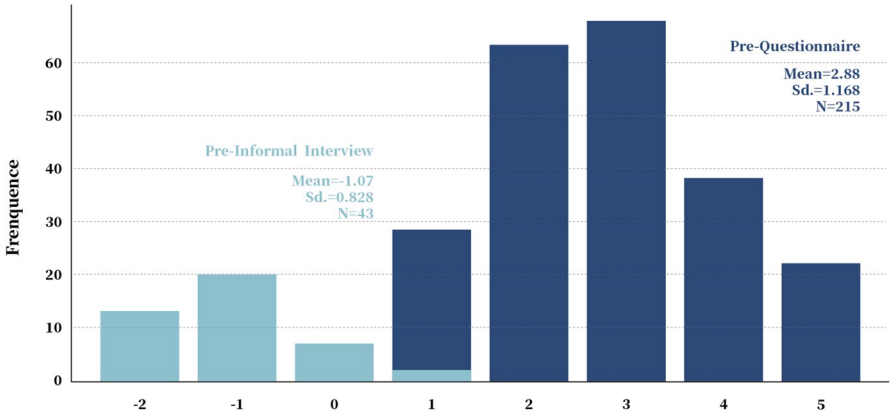
KMO and Bartlett's Test		
Kaiser- Meyer-Olkin Measure of Sampling Adequacy.		0.82
Bartlett's Test of Sphericity	Approx. Chi-Square	155.35
	df	10
	Sig.	.00

Table 2 Normality for motivation questionnaire

Tests of Normality						
	Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Stage1-CG-Q	0.17	22	.11	.93	22	.102
Stage2-CG-Q	0.25	22	.001	.89	22	.015
Stage1-EG-Q	0.25	22	.001	.89	22	.015
Stage2-EG-Q	0.22	22	.008	.91	22	.048

Lilliefors Significance Correction applied

learners' questionnaire answers, such as the example in Figs. 6 and 7. Researchers got a more comprehensive understanding of the individual motives that drew and kept participants in the learning process due to the extra interview with learners' parents. Additionally, the study would consider how well the students performed and participated in the evaluation.



Figs. 6 Histogram for pre-informal interview and pre-questionnaire

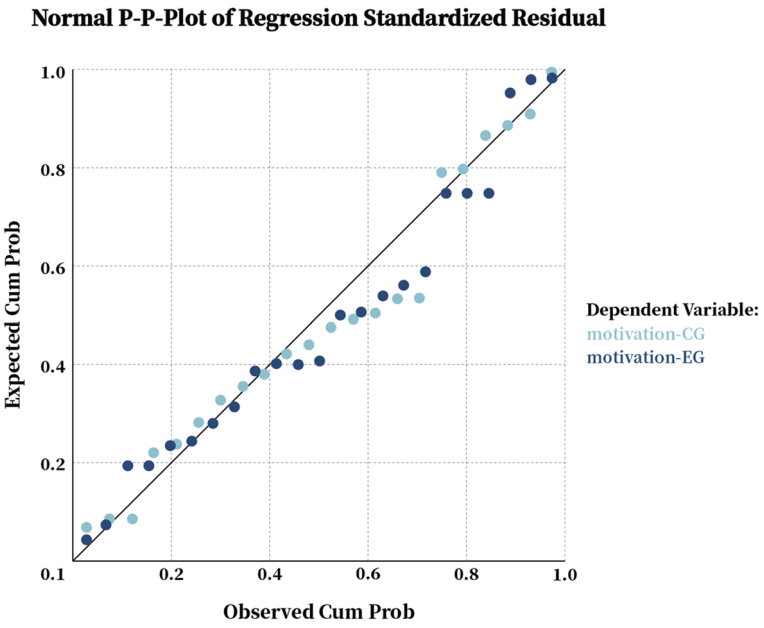


Fig. 7 Regression of students' motivation and accuracy

4.2 Internalization

While Table 3 shows the means and SDs for all the variables, Tables 4 and 5 show the pair correlations and pair differences representatively. Paired t-test in Table 4 showed that there are significant differences between the control group (CG) and the experimental group (EG) at the first stage and the second stage, and the EG's first stage and EG's second stage. All three pairs have shown the score of CG in stage one and stage two, and EG's two stages are strongly and positively correlated (r1 = 0.930, r2 = 0.851, r3 = 0.953, $p < 0.001$). As indicated in Table 4, EG scored

Table 3 Pair results from motivation of interview

Paired Sample Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair1	Stage1-CG	−0.86	22	1.17	0.25
	Stage1-EG	−0.09	22	1.11	0.24
Pair 2	Stage2-CG	−0.73	22	1.58	0.34
	Stage2-EG	0.82	22	1.56	0.33
Pair 3	Stage1-EG	0.00	23	1.17	0.24
	Stage2-EG	0.91	23	1.59	0.33

N = sample size

Table 4 Pair correlations results from motivation of interview

Paired Sampled Correlations				
		N	Correlations	Sig.
Pair1	Stage1-CG & Stage1-EG	22	0.93	0.00
Pair1	Stage2-CG & Stage2-EG	22	0.85	0.00
Pair1	Stage1-EG & Stage2-EG	23	0.95	0.00

N = sample size

Table 5 Pair differences results from motivation of interview

Paired Samples Test									
Paired Differences									
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Stage1-CG & Stage1-EG	-0.77	0.43	0.091	-0.96	-0.58	-8.45	21	0.00
Pair 2	Stage2-CG & Stage2-EG	-1.55	0.86	0.18	-1.93	-1.17	-8.45	21	0.00
Pair 3	Stage1-EG & Stage2-EG	-0.91	0.60	0.12	-1.17	-0.66	-7.34	22	0.00

significantly higher than CG in both stage 1 and stage 2. The finding that there was a difference between the CG and EG in the first stage (−.773 in means) confirms earlier findings that "gamification" can increase learners' motivation and affective outcomes by having them compete and earn points during activities when it is properly guided (Hamza et al., 2022; Hijriyah et al., 2018; Hamzah et al., 2015). Without teachers' guidance and requirement, compared with stage 1, the difference between the CG and EG in stage 2 is higher, with −1.545 in the mean. This can be explained by the fact that experimental students have a greater desire to learn and complete the task in the absence of deadlines and extra prizes. Thus, it indicates that gamified assessment leads individuals to place more value on the purpose of learning in addition to task accomplishment. The gamification with a more highly encouraged engagement setting satisfies their psychological demands for greater motivation.

As indicated in Table 6 includes the data collected for students' performance in assessments. Compared with the CG's 74.01% accuracy, the overall students' accuracy of EG 89.05% is higher. If we compare the accuracy between the two stages, it becomes clear that the gap between the CG (54.72%) and EG (86.02%) groups is greater in the second stage. The accuracy of the students varied more widely in the CG group, with a higher standard deviation (SD = 17.08). These findings suggest that EG students possess greater knowledge competence and less discernible

Table 6 Data from EFL's assessment accuracy

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Accuracy-CG	74.01	22	17.80	3.80
	Accuracy-EG	89.06	22	7.46	1.59

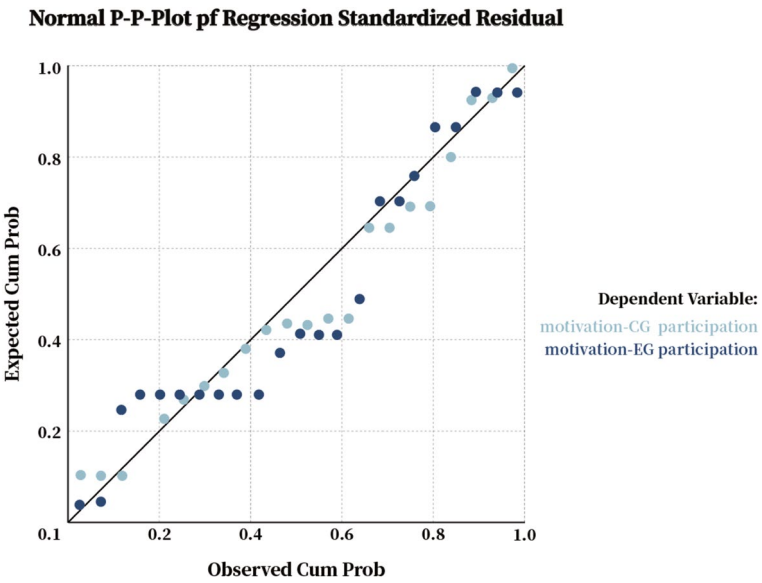


Fig. 8 Regression of students' motivation and completion

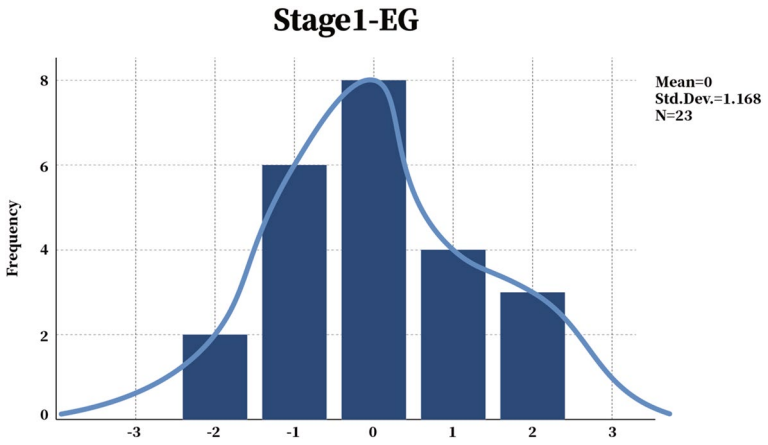


Fig. 9 Students' motivation in EG of the first stage

differences. By applying regression in SPSS, Figs. 8 and 9, show the linear relationship between motivation and competence. This confirmed that motivation in learners could actively promote learners' competencies (Blömeke et al., 2015). Accordingly, transfer motivation should generally profit from fostering students' competence, which explains their increased competence in accuracy. (Alsawaier, 2018). Thus, the higher motivations fit with, the higher accuracy.

Another data that should be noticed is the student's participation in assessment, which shows the relationship between Gamification and engagement. Especially the difference increases in the second stage between the CG (absence: 15.23%) and EG (absence:1.09%). No matter how it is marketed, student involvement must be motivated by educational goals (Beer, 2010; Bulger et al., 2008). The findings indicated that gamification enhanced students' involvement (Gomes et al., 2016). Single regression analysis in Fig. 10 revealed a strong positive association between motivation and

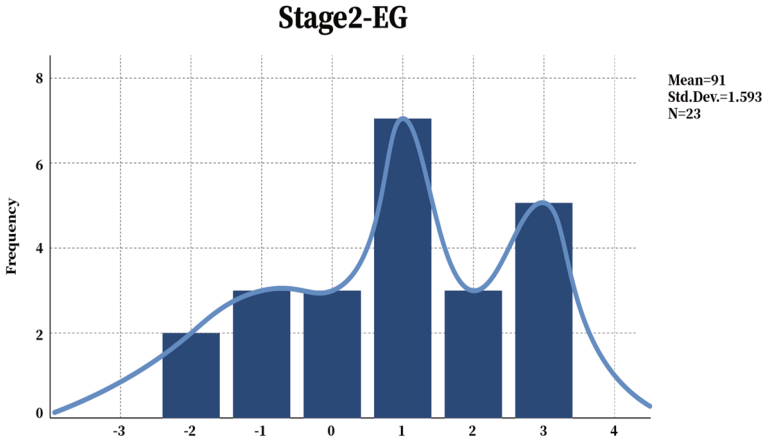


Fig. 10 Students' motivation in EG of the second stage

completion. It demonstrates the close relationship between task completion and student participation in learning activities (Sonnentag, 2017). As said in the research, gamification can boost work completion and improve task value among learners (Brewer et al., 2013; Alsawaier, 2018). Besides, we conclude more corroborated qualitative data like student reattempt in the assessment that over 43.48% of assessments in EG be taken more than twice. In contrast, in CG, the reattempt rate is much lower (25%) It indicates the effectiveness of gamified components for increasing student interest in tasks, facilitating task completion, and learning. These results fit the student's opinion that game quizzes motivated them to complete the assigned tests.

The results in Table 7 below show the student's motivation in the pre-questionnaire. Most students (81.40%, 76.74%, 72.09%, 67.44%, 65.12% for five questions) Strongly dislike, Dislike, or Neutral towards the traditional formative assessments they have taken before. Hence, compared with the results in the pre-questionnaire (mean = −1.07), the post-questionnaire shows students' motivation greatly increases (mean = −0.15). Quizizz's gamified evaluation thereby aids EFL students in internalizing their motivation at a higher level.

4.3 Level of extrinsic motivation

Most EG students (Mode = 8) in the first stage are on the extrinsic motivation of stage introjected regulation in Fig. 11, which is partially internalized. This reward is in line with an individual's own self-determined ideals in feeling, as opposed to meeting performance standards (Ryan & Deci, 2000). Since the initial step of the gamified evaluation incorporates components of ranking and badges, this may be explained by ego involvement during the learning process. Students finished the assignment for emotional fulfillment during the process in addition to the praises and rewards. The majority of these pupils stated in the interviews that they would feel content after finishing the task. and enjoy doing the Quizizz. This can be caused by the competitive environment that Quizizz provides, which promotes students' engagement and attention. Wang (2015) also investigated and confirmed the competitive effect of Kahoot! on students' attention. As a result, game components like points, levels, or trophies do increase students' motivation from an emotional standpoint.

Table 7 Data from the pre-questionnaire of five questions

	Range	Minimum	Maximum	Sum	Mean		Std. Deviation Statistic	Variance Statistic
					Statistic	Std. Error		
Q1	4	1	5	116	2.58	0.18	1.20	1.43
Q2	4	1	5	130	2.89	0.18	1.19	1.42
Q3	4	1	5	149	3.31	0.18	1.20	1.45
Q4	4	1	5	133	2.96	0.18	1.22	1.50
Q5	4	1	5	137	3.04	0.16	1.09	1.18

Valid N (listwise) = 45

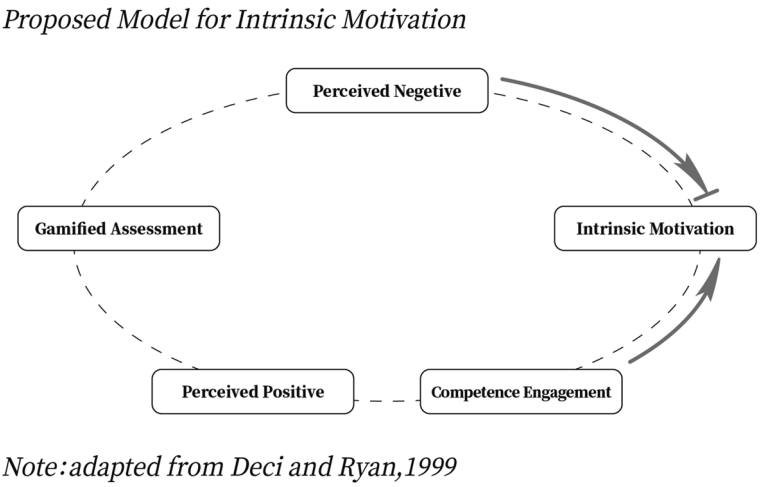


Fig. 11 Proposed model for intrinsic motivation. *Note*: adapted from Deci et al., 1999

The majority of EG students (mode = 7) in the second stage are on identified regulation stages that are somewhat internal, confirming their internalization in Fig. 10. It might be brought on by the feedback system, which might be viewed as controlling or informative and affect need fulfillment and motivation in various ways as a result. In contrast to the first stage, when students were drawn in by the game's competition, this stage's pupils gain more from the interactive, real-time feedback system of gamification. Students at this level who were questioned shared their fresh perspectives on the examination, such as how it helps in knowledge mastery and identifies areas of weakness. In the interviews, the majority of students (60.87%) stated that they often check assessments and note their errors. One advantage of Quizizz, according to the students, is that it makes it simple to identify the material that still must be mastered. The feedback mechanism allows them to examine and consolidate their information, which accounts for their increased drive. As a result, Quizizz's gamified examination with structured feedback might help students achieve imposed control.

4.4 Intrinsic motivation

Based on their responses to the questionnaire and interview questions, this study demonstrates that five individuals are considered to have achieved intrinsic motivation. Additionally, their altered motivation is positively correlated with their intrinsic incentive to use gamification tools like points, leaderboards, and badges. To verify their intrinsic motivation, we consider their parents' interview data. In addition to their high accuracy and reattempt in the assessment, there are some changes in students' attitudes and behaviors. For example, they gradually organized time for Quizizz in the second stage and spent time reviewing before the Quizizz. There are numerous study domains have had success with raising intrinsic motivation to alter behavior Lee et al. (2013). According to the interview, some keywords are all

mentioned by those students, like curiosity and enjoyment. Their initial interest in the evaluation can be attributed to a motivational state that fosters engagement and encourages exploratory activity. The joy of the task, which includes their sense of success for winning a game, served as an intrinsic incentive since students find it enjoyable and satisfying. It demonstrated that motivation is impacted by both enjoyment and curiosity (Kashdan et al., 2004).

This study won't evaluate intrinsic motivation participants' type in-depth due to the relatively limited size. However, this study discussed the possible factors that influence intrinsic achievement. Different from intrinsic participants who regard the assessment as the experienced master, amonitvation students still believe the assessment is a work to finish and neglect the feedback as well. Students who are more internally motivated than those five demonstrate that they no longer view the evaluation as homework given to them by a teacher. Unlike intrinsic students who view the ranking and "gift card" as social connections, they feel negative peer pressure under the competition. Thus, it suggested the following model in Fig. 11 (adapted from Deci et al., 1999; Nacke & Deterding, 2017), which states that when the environment is seen as fostering autonomy and specific learning tasks, students' intrinsic motivation is increased; however, managing educational settings decreases intrinsic drive.

Figure 11 shows that the intrinsic motivation model is a psychological theory, which is used to explain the reasons and mechanisms of individuals engaging in certain activities driven by their hearts. The model holds that the motivation of individuals to participate in activities mainly comes from the intrinsic value of the activities themselves and the autonomy of individuals. The intrinsic motivation model includes the following elements: perceived negation, intrinsic motivation, ability participation, positive feeling, and gamification evaluation. Among them, internal automata are the internal driving force for individuals to feel capable of deciding their own actions and choosing the direction of action according to their own values and interests. Ability participation means that individuals pursue challenges and growth, and seek opportunities to improve their skills and abilities in activities. Feeling positive means that individuals are eager to establish contacts and relationships with others, and they will feel happy when interacting and cooperating with others in activities. Gamification evaluation refers to evaluating the inner activities involved in this game in a gamification way, without making the participants feel bored.

The specific operation process is as follows: the motivation of individuals to participate in activities comes from their interest and enjoyment of the activities themselves. Individuals find activities interesting and challenging, and can provide satisfaction and sense of accomplishment. Individuals feel autonomous in their activities and have the right to decide the direction and way of action independently, without being restricted by external pressure and control. Individuals improve their skills and abilities by participating in activities, and pursue challenges and opportunities for growth. The sense of accomplishment and progress experienced by individuals in gamification activities has enhanced their motivation for activities. Meanwhile, individuals can establish a sense of belonging and connection through interaction and cooperation with others, and interaction and support with others can enhance the intrinsic motivation of individuals. It shows that the intrinsic motivation model proposed in this paper emphasizes the internal motivation and autonomy of individuals,

and believes that individuals will have stronger motivation to enjoy and grow in the process of gamification evaluation, and show higher investment and persistence in activities. This model has important enlightenment and application value for understanding individual behavior and incentive mechanism.

5 Conclusion

This research examines the impact of gamified formative assessment on EFL motivation. By integrating the theories of SDT, this paper classifies students' motivation and analyzes engagement and learning competence. The evaluation with game components is conceptually assumed to aid learners in raising their motivation to a greater degree. In this paper, the gamified assessment promotion to students' internalization is validated (Li et al., 2019; Mitchell et al., 2020) under the context of formative assessment and EFL at the elementary level. The instrument of CiteSpace, questionnaire, interview, and Quizizz's report is used for data collection ($n=45$), and data are analyzed using Paired t-test, the simple linear in SPSS. The gamified assessments suit learners' mental needs in introjected regulation and knowledge recognition in identified regulation thanks to the clear feedback and challenge of an uncertain environment.

It is also found that students' motivation level matches their engagement and language accuracy. This paper provided the hypothesis that gamification promotes the learners' motivation as an internal element, which results in their high competence and participation in assessment, in order to incorporate previous research regarding gamification and participation (Barata et al., 2013). Furthermore, our research reveals that learners' perceptions of gamified assessments as either controlled or assistive factors in internalization success.

With the findings, our study makes several theoretical and practical contributions to pedagogy and gamified system construction. First, gamified formative assessment could be applied to teachers and students in the classroom. While there are many elements that affect how teachers utilize technology, the Barrier to Technology Integration model (Ertmer, 1999; Hew & Brush, 2007) mentions barriers such as value beliefs and aptitude that limit how much technology integration instructors are able to do. According to this study, instructors may use Quizizz successfully and with fewer barriers to the majority of students' favorable attitudes. Teachers can effectively educate students and inspire them to place importance on the test's purpose with the aid of Quizizz in order to increase their motivation. Second, the online platform was created well for cooperative gaming components and for creating customizable learning settings. Still, it needs to give more consideration to differentiation and invisible barriers like complex operations. For instance, the system may change into a structure without a dashboard depending on how various students feel about the competition. Another element to take into account for the decline in motivation is the updating system.

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Data availability The datasets generated during and/or analyzed during the current study are not publicly available but are available from the corresponding author upon reasonable request.

Declarations

Ethical approval All research was approved by the University of South California, Rossier School of Education. I have obtained informed written consent from the participants in the study. Since children are involved, they have informed consent from their parents and legal representatives.

Competing interests Not applicable.

References

Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology, 35*(1), 56–79.

Alvia González, G. N. (2022). *The influence of gamification on speaking skills*. Facultad de Filosofía, Letras y Ciencias de la Educación: Universidad de Guayaquil.

Amoah, S., & Yeboah, J. (2021). The speaking difficulties of Chinese EFL learners and their motivation towards speaking the English language. *Journal of Language and Linguistic Studies, 17*(1), 56–69.

Attali, Y., & Arieli-Attali, M. (2015). Gamification in assessment: Do points affect test performance? *Computers & Education, 83*, 57–63.

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013). Improving participation and learning with gamification. In *Proceedings of the First International Conference on gameful design, research, and applications* (pp. 10–17).

Beer, L. E. (2010). Contemplative administration: Transforming the workplace culture of higher education. *Innovative Higher Education, 35*(4), 217–231.

Bennett, R. E. (2011). Formative assessment: A critical review. *Assessment in Education: Principles, Policy & Practice, 18*(1), 5–25.

Bitonto, P. D., Corriero, N., Pesare, E., Rossano, V., & Roselli, T. (2014). Training and learning in e-health using the gamification approach: The trainer interaction. In *International conference on universal access in human-computer interaction* (pp. 228–237). Springer.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education: Principles, Policy & Practice, 5*(1), 7–74.

Black, P., & Wiliam, D. (2003). 'In praise of educational research': Formative assessment. *British Educational Research Journal, 29*(5), 623–637.

Blömeke, S., Hoth, J., Döhrmann, M., Busse, A., Kaiser, G., & König, J. (2015). Teacher change during induction: Development of beginning primary teachers' knowledge, beliefs and performance. *International Journal of Science and Mathematics Education, 13*(2), 287–308.

Boston, C. (2002). The concept of formative assessment. *Practical Assessment, Research, and Evaluation, 8*(1), 9.

Brewer, R., Anthony, L., Brown, Q., Irwin, G., Nias, J., & Tate, B. (2013). Using gamification to motivate children to complete empirical studies in lab environments. In *Proceedings of the 12th international conference on interaction design and children* (pp. 388–391).

Brigham, T. J. (2015). An introduction to gamification: Adding game elements for engagement. *Medical Reference Services Quarterly, 34*(4), 471–480.

Brown, S. R. (1993). A primer on Q methodology. *Operant Subjectivity, 16*(3/4), 91–138.
Buckley, P., & Doyle, E. (2016). Gamification and student motivation. *Interactive Learning Environments, 24*(6), 1162–1175.
Bulger, S. M., Housner, L. D., & Lee, A. M. (2008). Curriculum alignment: A view from physical education teacher education. *Journal of Physical Education, Recreation & Dance, 79*(7), 44–49.
Campillo-Ferrer, J. M., Miralles-Martínez, P., & Sánchez-Ibáñez, R. (2020). Gamification in higher education: Impact on student motivation and the acquisition of social and civic key competencies. *Sustainability, 12*(12), 4822.
Chan, E., Nah, F. F. H., Liu, Q., & Lu, Z. (2018). Effect of gamification on intrinsic motivation. In *International conference on HCI in business, government, and organizations* (pp. 445–454). Springer.
Chapman, J. R., & Rich, P. J. (2018). Does educational gamification improve students' motivation? If so, which game elements work best? *Journal of Education for Business, 93*(7), 315–322.
Connell, J. P., & Ryan, R. M. (1984). A developmental theory of motivation in the classroom. *Teacher Education Quarterly,* 64–77.
Cowie, B., & Bell, B. (1999). A model of formative assessment in science education. *Assessment in Education: Principles, Policy & Practice, 6*(1), 101–116.
da Rocha Seixas, L., Gomes, A. S., & de Melo Filho, I. J. (2016). Effectiveness of gamification in the engagement of students. *Computers in Human Behavior, 58*, 48–63.
Denton, P., Madden, J., Roberts, M., & Rowe, P. (2008). Students' response to traditional and computer-assisted formative feedback: A comparative case study. *British Journal of Educational Technology, 39*(3), 486–500.
Deterding, S. (2012). Gamification: Designing for motivation. *Interactions, 19*(4), 14–17.
Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). *From game design elements to gamefulness: defining gamification*. Paper presented at the Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments.
Deci, E. L., Ryan, R. M., Deci, E. L., & Ryan, R. M. (1985). Conceptualizations of intrinsic motivation and self-determination. In *Intrinsic motivation and self-determination in human behavior* (pp. 11–40). Boston, MA: Springer. https://doi.org/10.1007/978-1-4899-2271-7_2
Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality, 62*(1), 119–142.
Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin, 125*(6), 627.
Ertmer, P. A. (1999). Addressing first-and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47–61.
Gamlo, N. (2019). The impact of Mobile game-based language learning apps on EFL Learners' motivation. *English Language Teaching, 12*(4), 49–56.
Gardner, J. N., & Gardner, J. (2012). *Assessment and learning*. Sage.
Georgiou, K., Gouras, A., & Nikolaou, I. (2019). Gamification in employee selection: The development of a gamified assessment. *International Journal of Selection and Assessment, 27*(2), 91–103.
Gomes, D. A., Pimentel, E. A., & Voskanyan, V. (2016). *Regularity theory for mean-field game systems*. Springer.
Bouafia, K., & Hamza, L. (2022). Game theory approach for analysing attack graphs. *International Journal of Information and Computer Security, 19*(3–4), 305–320.
Hamzah, W. M. A. F. W., Ali, N. H., Saman, M. Y. M., Yusoff, M. H., & Yacob, A. (2015). Influence of gamification on students' motivation in using e-learning applications based on the motivational design model. *International Journal of Emerging Technologies in Learning (iJET), 10*(2), 30–34.
Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development, 55*(3), 223–252.
Hijriyah, E. M., Darmawan, E., & Zamzami, M. R. A. (2018). Enhancing biology students motivation through classroom action research based STAD learning model. *Indonesian Journal of Biology Education, 1*(1), 9–16.
Ibrahim, R., & Jaafar, A. (2009). Educational games (EG) design framework: Combination of game design, pedagogy and content modeling. In *2009 international conference on electrical engineering and informatics* (Vol. 1, pp. 293–298). IEEE.
Kashdan, T. B., Rose, P., & Fincham, F. D. (2004). Curiosity and exploration: Facilitating positive subjective experiences and personal growth opportunities. *Journal of Personality Assessment, 82*(3), 291–305.

Kiyançiçek, E., & Levent, U. Z. U. N. (2022). Gamification in English language classrooms: The case of Kahoot! *Bilim Eğitim Sanat ve Teknoloji Dergisi, 6*(1), 1–13.

Kopinska, M., & Azkarai, A. (2020). Exploring young EFL learners' motivation: Individual versus pair work on dictogloss tasks. *Studies in Second Language Learning and Teaching, 10*(3), 607–630.

Krashen, S. (1994). The pleasure hypothesis. In J. Alatis (Ed.), *Georgetown University round table on languages and linguistics* (pp. 299–302). Washington, DC: Georgetown University Press.

Lee, J. J., Matamoros, E., Kern, R., Marks, J., & de Luna, C. (2013). Greenify fostering sustainable communities via gamification. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems,* (pp. 1497–1502).

Li, X., Xia, Q., Chu, S. K. W., & Yang, Y. (2022). Using gamification to facilitate students' self-regulation in e-learning: A case study on students' L2 English learning. *Sustainability, 14*(12), 7008.

Li, L., Liu, D., Zhang, Q., Song, K., Zhou, X. J., Tang, Z., & Zhou, X. (2019). Occurrence and ecological risk assessment of selected antibiotics in the freshwater lakes along the middle and lower reaches of Yangtze River Basin. *Journal of Environmental Management, 249*, 109396. https://doi.org/10.1016/j.jenvman.2019.109396

Linn, R., & Miller, M. (2005). *Measurement and assessment in teaching*. Pearson Prentice Hall.

Lohitharajah, J., & Youhasan, P. (2022). Utilizing gamification effect through Kahoot in remote teaching of immunology: Medical students' perceptions. *Journal of Advances in Medical Education & Professionalism, 10*(3), 156.

Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PLoS One, 12*(3), e0173403.

Menezes, C. C. N., & De Bortolli, R. (2016). Potential of gamification as assessment tool. *Creative Education, 7*(4), 561–566.

Mitchell, R., Schuster, L., & Jin, H. S. (2020). Gamification and the impact of extrinsic motivation on needs satisfaction: Making work fun? *Journal of Business Research, 106*, 323–330.

Mudure-Iacob, I. (2021). Gamified assessment of business English: Learning and testing business idioms and collocations via digital escape rooms. *Lingua. Language and Culture, 20*(1), 76–90.

Muthukumar, B., & Neelakandan, V. (2019). Enriching "speaking skills" through gamification with cultural considerations. *Think India Journal, 22*(4), 4062–4065.

Nacke, L. E., & Deterding, C. S. (2017). The maturing of gamification research. *Computers in Human Behaviour, 71*, 450–454.

Namaziandost, E., Neisi, L., Kheryadi, & Nasri, M. (2019). Enhancing oral proficiency through cooperative learning among intermediate EFL learners: English learning motivation in focus. *Cogent Education, 6*(1), 1683933.

Namaziandost, E., Razmi, M. H., Ahmad Tilwani, S., & Pourhosein Gilakjani, A. (2022). The impact of authentic materials on reading comprehension, motivation, and anxiety among Iranian male EFL learners. *Reading & Writing Quarterly, 38*(1), 1–18.

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199–218.

Nuri, H. S. M., Qadir, S. M., Mohammed, R. R., & Azaldin, A. H. (2022). Perceptions of postgraduate students towards the use of Kahoot as a formative assessment tool in an English language course. *Journal of University of Raparin, 9*(5), 229–251.

Oviedo, F. C., & Charpentier, K. A. (2023). Gamification in education for the formative assessment process. *Ciencia Latina Revista Científica Multidisciplinar, 7*(1), 9180–9194.

Oxford Online English. (2022). https://www.oxfordonlineenglish.com/english-level-test/vocabulary

Pishghadam, R., Derakhshan, A., Jajarmi, H., Tabatabaee Farani, S., & Shayesteh, S. (2021). Examining the role of teachers' stroking behaviors in EFL learners' active/passive motivation and teacher success. *Frontiers in Psychology, 12*, 707314.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68.

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Publications.

Safdari, S. (2021). Operationalizing L2 motivational self system: Improving EFL learners' motivation through a vision enhancement program. *Language Teaching Research, 25*(2), 282–305.

Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis. *Educational Psychology Review, 32*(1), 77–112.

See, B. H., Gorard, S., Lu, B., Dong, L., & Siddiqui, N. (2022). Is technology always helpful?: A critical review of the impact on learning outcomes of education technology in supporting formative assessment in schools. *Research Papers in Education, 37*(6), 1064–1096.

Sonnentag, S. (2017). A task-level perspective on work engagement: A new approach that helps to differentiate the concepts of engagement and burnout. *Burnout Research, 5*, 12–20.

Song, Y., & Sparks, J. R. (2019). Building a game-enhanced formative assessment to gather evidence about middle school students' argumentation skills. *Educational Technology Research and Development, 67*, 1175–1196.

Vrcelj, A., Hoic-Božic, N., & Dlab, M. H. (2023). Use of gamification in primary and secondary education: A systematic literature review. *International Journal of Educational Methodology, 9*(1), 13–27.

Vygotsky, L. S. (2012). *Thought and language*. MIT press.

Wang, A. I. (2015). The wear out effect of a game-based student response system. *Computers & Education, 82*, 217–227.

Wee, S. C., & Choong, W. W. (2019). Gamification: Predicting the effectiveness of variety game design elements to intrinsically motivate users' energy conservation behaviour. *Journal of Environmental Management, 233*, 97–106.

Werbach, K., Hunter, D., & Dixon, W. (2012). *For the win: How game thinking can revolutionize your business* (vol. 1). Philadelphia: Wharton digital press.

Wiliam, D., & Thompson, M. (2008). Integrating assessment with learning: What will it take to make it work? In C. A. Dwyer (Ed.), *The future of assessment: Shaping teaching and learning* (pp. 53–82). Erlbaum.

Wood, L., Teras, H., Reiners, T., & Gregory, S. (2013). The role of gamification and game-based learning in authentic assessment within virtual environments. *Research and Development in Higher Education: The Place of Learning and Teaching, 36,* 514–523.

Xi, N., & Hamari, J. (2020). Does gamification affect brand engagement and equity? A study in online brand communities. *Journal of Business Research, 109*, 449–460.

Yam, S., & Rossini, P. E. T. E. R. (2013). *Online and traditional formative assessment: Experience from a first-year property course* (Doctoral dissertation, PRRES-Pacific Rim Property Research Journal).

Yassin, B., & Abdulgalil Abugohar, M. (2022). Gamified mobile-assisted formative assessment for reviving undergraduate learners' overall language proficiency: A quasi-experimental study. *Teaching English with Technology, 22*(2), 69–89.

Zhorova, I., Kokhanovska, O., Khudenko, O., Osypova, N., & Kuzminska, O. (2022). Teachers are training for the use of digital tools of the formative assessment in the implementation of the concept of the new Ukrainian school. *Educational Technology Quarterly, 2022*(1), 56–72.