

**THE EFFECTS OF FORMATIVE GAMIFIED
FEEDBACK INTEGRATED IN LEARNENGLISH
APPLICATION ON STUDENTS' ACADEMIC
PERFORMANCE, ONLINE ENGAGEMENT AND
SELF-REGULATED LEARNING FOR GRADE 10
STUDENTS IN OMAN**

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UNIVERSITI SAINS MALAYSIA

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by

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**KESAN MAKLUM BALAS FORMATIF YANG DIGAMIFIKASI
DALAM APLIKASI LEARNENGLISH TERHADAP PRESTASI
AKADEMIK, PENGLIBATAN DALAM TALIAN DAN PEMBELAJARAN
KENDIRI DALAM KALANGAN PELAJAR TINGKATAN 10 DI OMAN**

ABSTRAK

Disebabkan kelemahan prestasi akademik serta tahap penglibatan pelajar dalam talian dan pembelajaran terkawal sendiri yang rendah dalam kalangan pelajar sekolah menengah, maka kajian ini dijalankan. Oleh itu, kajian ini bertujuan untuk mereka bentuk dan membangunkan aplikasi maklum balas formatif gamified dengan menyepadukan elemen gamifikasi, prinsip penilaian formatif, dan prinsip maklum balas bagi meningkatkan prestasi akademik pelajar, penglibatan dalam talian, serta pembelajaran terkawal sendiri dalam talian dalam kalangan pelajar dengan dua gaya kognitif yang berbeza. Selain itu, kajian ini bertujuan mencadangkan satu model ramalan yang boleh digunakan untuk mempromosikan prestasi akademik pelajar menggunakan teknik *decision tree* dalam analisis data. Bagi menjawab objektif dan persoalan kajian ini, reka bentuk kuasi-eksperimen telah digunakan dengan pendekatan analisis faktorial 2 x 2. Kajian ini melibatkan dua mod maklum balas, iaitu mod maklum balas formatif gamified dan mod maklum balas penjelasan formatif gamified sebagai pembolehubah tidak bersandar, manakala gaya kognitif (Holists dan Serialists) dijadikan sebagai moderator. Sampel kajian terdiri daripada pelajar tahun ke-10 yang bersekolah di institusi pendidikan kerajaan. Data dikumpulkan dan dianalisis menggunakan statistik inferensi, iaitu ujian-t bebas dan ANOVA dua hala. Keputusan kajian menunjukkan bahawa terdapat kesan utama yang signifikan antara kumpulan eksperimen dan kumpulan perbandingan dalam prestasi akademik serta

pembelajaran terkawal sendiri dalam talian, manakala kesan utama terhadap penglibatan dalam talian adalah tidak signifikan. Walau bagaimanapun, kesan interaksi maklum balas formatif gamified menunjukkan kesan yang signifikan terhadap pembelajaran terkawal sendiri dalam talian tetapi tidak terhadap prestasi akademik dan penglibatan dalam talian. Selain itu, model ramalan yang dicadangkan menghasilkan keputusan yang tepat dengan mengambil kira kekerapan permainan, pengetahuan sedia ada, dan percubaan dalam kuiz sebagai faktor penting dalam meramal prestasi akademik pelajar. Kajian ini dapat memperluaskan pemahaman guru dan penggubal dasar mengenai faedah penyepaduan maklum balas formatif dan elemen gamifikasi serta membantu pelajar meningkatkan prestasi akademik, penglibatan dalam talian, dan pembelajaran terkawal sendiri dalam talian mereka.

**THE EFFECTS OF FORMATIVE GAMIFIED FEEDBACK
INTEGRATED IN LEARNENGLISH APPLICATION ON STUDENTS'
ACADEMIC PERFORMANCE, ONLINE ENGAGEMENT AND SELF-
REGULATED LEARNING FOR GRADE 10 STUDENTS IN OMAN**

ABSTRACT

Due to weaknesses in students' academic performance, low online engagement, and self-regulated learning among secondary students, the current study was conducted. Hence, this study aims to design and develop a gamified formative feedback application by integrating gamification elements, formative assessment principles and the feedback principle to enhance students' academic performance, online engagement, and online self-regulated learning for students with two cognitive styles. Besides, the study aims to propose a predictive model that can be used to promote students' academic performance using a data decision tree. To achieve the purposes of this study, a quasi-experimental design was employed using a 2 x 2 factorial analysis. This study includes a gamified formative feedback mode and a gamified formative explanatory feedback mode as an independent variable whereas cognitive style (Holists and Serialists) was rendered as a moderator. The sample of the study consisted of grade ten students studying at a government school. The data were collected and analysed using inferential statistics, namely, independent t-tests and two-way ANOVA. The results of the study indicated that there was a significant main effect between the experimental group and the comparison group in academic performance and online self-regulated learning whereas the main effect of online engagement was not significant. However, the interaction effect of the gamified formative feedback was significant on online self-regulated learning but not on academic performance and

online engagement. Moreover, the proposed predictive model yielded accurate and precise results considering gaming frequency, prior knowledge and quiz attempts as significant potential factors in predicting students' academic performance. This study could broaden teachers' and policymakers' understanding of the benefits of integrating formative feedback and gamification elements, thereby helping students promote their academic performance, online engagement, and online self-regulated learning.

CHAPTER 1

INTRODUCTION

1.1 Overview

People around the world have been increasingly turning to technology to enhance every aspect of their lives. The most distinguished feature of the current situation in the world is the rapid change that occurs every day. The global educational system should, therefore, be compatible with these changes and should innovate new methods of delivering materials for students at schools and universities. In the last few decades, new teaching methods and techniques have emerged to suit the various changes that occur daily and to develop the cognitive, behavioural, social and affective skills for the millennial students.

The responsibility of the school is not only to provide students with knowledge and information that the teacher delivers in the classrooms, but it also has the potential responsibility to cater to the cognitive skills that they can use in every aspect of their lives (Kyriakides et al., 2020). Hence, it is necessary to develop students' skills to encourage them to engage consciously in the learning process, to self-regulate their learning, and to increase their academic performance. These skills and cognitive processes could be promoted by employing recent advanced technology like gamification accompanied by some types of feedback, like corrective and explanatory feedback (Makransky et al., 2020; Mimouni, 2022).

1.2 Background of the Study

Some schools and universities employed fully face-to-face teaching, while others used a blended learning approach as their primary method of lesson and lecture

delivery. In addition, some primary and secondary teachers teach their students in a synchronous mode using known video-conferencing platforms such as Google Meet and Webex and some schools prefer delivering materials through learning management systems such as Moodle and Google Classroom platforms (Zainuddin et al., 2022). In the Omani context, the Omani Education Council published a booklet that encompasses the main principles of the philosophy of education in Oman (The Education Council, 2017). The booklet contains 34 principles, and the thirteenth principle posits that research and innovation should be encouraged to "[p]rovide learning environments that stimulate thinking, exploration, researching and innovating" (The Education Council, 2017, p. 26). Therefore, teachers in Oman are advised to leverage technology in teaching various disciplines (Al-Ani, 2016). They are also informed to utilize technological tools both inside and outside the classroom, enabling students to overcome the challenges they encounter while acquiring different types of knowledge (Al-Ani, 2016). Moreover, the Omani Ministry of Education issued a guideline in October 2020 to support teachers in different subjects to use various technological tools and applications (Ministry of Education, 2020). This guideline booklet provides valuable information on using various applications in both classroom and non-classroom settings, offering concrete examples of their application across different subjects. In addition, to encourage teachers to use the available learning management systems, the Omani Ministry of Education issued a booklet in 2022 to guide teachers on how to employ them in a proper manner (General Directorate of Educational Supervision, 2022). This booklet contains valuable information on the steps that teachers should follow when using educational applications. Similarly, the Ministry of Education launched another booklet to help students easily access the learning management systems (Ministry of Education, 2024). In 2022, the Ministry of

Education launched the Microsoft Teams initiative in collaboration with Microsoft to encourage teachers to use online teaching, whether synchronously or asynchronously. The first stage of this initiative targeted 30 schools around Oman from different governorates (Department of Educational Technologies, 2022). This initiative targets all teachers from different subjects, aiming to utilize technology in teaching and train them to use educational applications for delivering materials to students. According to Mohammed Al-Ghafri, who is responsible for the initiative in the General Directorate of Albatna North Governorate (personal communication, September 22, 2023), 145 schools joined the initiative around Oman in the academic year 2023/2024. Regarding learning English as a foreign language, students face many challenges. At the same time, they attempt to master the skills of the language (Alrashidi & Phan, 2015), thus, teaching English has received more attention in recent years in Oman and teachers are advised to follow modern global trends to meet the new technological developments around the world (Al-Habsi et al., 2022). As such, the Omani Ministry of Education has been developing new syllabuses for grade 1-12 students in recent years (Al Arawi, 2023) and, at the same time, encourages teachers to utilize learning management systems by providing guidelines on how to use them (General Directorate of Educational Supervision, 2022). Students and their parents suggest employing a variety of activities and assessment tools to improve their learning performance (Al Arawi, 2022). Therefore, it is recommended that these developments should be accompanied by engaging and motivating techniques when teaching English as a foreign language (Al Jahdhami et al., 2021; Sun & Hsieh, 2018).

1.2.1 Gamification, Formative Feedback and Academic Performance

Gamification is defined as using game elements in a non-game context (Deterding et al., 2011). Many studies have investigated the effect of gamification on students' performance. Some studies found positive effects of gamification on learning performance (Hong et al., 2020; Hung, 2017; Philpott & Son, 2022; Rachels & Rockinson-Szapkiw, 2018). However, some studies reported adverse or insignificant effects of gamification on academic performance (e.g., Alsadoon et al., 2022; Balci et al., 2022; Göksün & Gürsoy, 2019; Noor et al., 2022). Therefore, the current study attempts to reconcile the discrepancy in the literature regarding the effectiveness of using a gamified app as an effective tool for students' learning. On the other hand, explanatory feedback is to explain whether the answer is correct or wrong (Johnson & Priest, 2021). However, rare studies have integrated explanatory feedback in the gamified learning environment, as shown in Chapter 2 in the research gap section.

1.2.2 Gamified Formative Feedback and Students' Online Engagement

Gamified formative e-assessment is one type of gamification and it is widely used in the literature (e.g., Nadeem & Al Falig, 2020; Zainuddin, 2018; Zhang & Crawford, 2023). In the current study, e-assessment is considered formative or an assessment for learning where students receive feedback about their answers immediately after they respond. Besides, the teacher can also elicit some important facts about students' performance and their understanding. Black and Wiliam (2009) specified five strategies for formative assessment or assessment for learning. One of the most significant tenets of their theory is "[p]roviding feedback that moves learners forward" (Black & Wiliam, 2009, p. 8). In addition to having a competition among

students, which increases motivation and engagement, the gamified e-quizzes deliver immediate feedback, which can help students learn from their mistakes. Some studies reported adverse effects on students' engagement when implementing gamified assessment (e.g., Bustillo, Rivera, Guzmán, & Acosta, 2017; Sun & Hsieh, 2018). This study investigated whether gamified feedback, as a formative e-assessment tool, has a positive or negative impact on students' online engagement and sought to gain insights into the underlying reasons. Furthermore, there is a call by other researchers to conduct a study to investigate the effect of gamified assessment on students' online engagement (Zainuddin, 2018).

1.2.3 Gamified Formative Feedback and Online Self-regulated Learning

Few studies have investigated the role that gamification plays in online self-regulated learning (e.g., Deng et al., 2020; Li et al., 2022). One of these few studies was conducted by Deng et al. (2020). Regarding online self-regulated learning, Barnard et al. (2009) Argued that conventional self-regulation is different from online self-regulation in that online self-regulation is specifically pertinent to blended and online learning. Although some studies have confirmed that technology has positive effects on self-regulation skills, as mentioned previously, there is still a paucity of research on how gamified formative feedback can promote online self-regulation skills for learners in secondary school education. This study attempts to fill this lacuna by providing insights and findings regarding these issues. Also, some researchers suggested conducting studies to investigate the effects of gamified formative feedback on online self-regulated learning (McLaughlin & Yan, 2017).

1.2.4 Individual Differences

Regarding learners' cognitive styles, there are many types of them in the literature. Among these types is the holism and serialism cognitive styles postulated by Pask (1976) and then Ford (1985) designed a validated scale which contained 18 statements to identify these two types of learners' cognitive styles: (a) Holists and (b) Serialists. Holists are students who prefer to process information from whole to part, so they focus on a global view. Another attribute of holists is their ability to reorganize information, leading them to prefer adjusting themselves to use existing learning materials. However, Serialists are students who prefer to process information from part to whole, so they focus on procedural details. Another attribute of serialists is that they prefer using the existing learning materials without changing them. These two types of learning styles were found to benefit from the scaffolding e-assessment while learning English differently (Chen & Tseng, 2021). Moreover, studies have shown inconsistent results regarding the effects of cognitive styles on students' academic achievement in hypermedia learning system environments (Mampadi et al., 2011). Therefore, it is necessary to study the interaction effects of cognitive styles on students' academic performance, online engagement and online self-regulation skills in the gamified formative environment to resolve the inconsistent results.

Furthermore, the previous individual differences are theory-driven characteristics, meaning that the researchers depend on theories to determine their effects. However, there are some data-driven hidden factors that previous studies may have or have not tackled such as socio-economic status, gaming experience, age or gender. These factors are analyzed using one of the data mining techniques called a data decision tree, and they work as factors that could help explain the variability of

the learning outcomes (Brandmaier et al., 2013b). Therefore, this study provides an essential opportunity to advance the understanding of other hidden factors that could influence students' academic performance while learning EFL using gamified formative e-assessment feedback.

Therefore, this study has several contributions to the field of study and body of knowledge. First, this study examines the effect of gamified formative feedback on students' academic performance, online engagement and online self-regulated learning. This contributes to current literature, as prior studies yielded inconsistent findings when integrating gamification elements and formative feedback on different learning outcomes (i.e., Bellhäuser et al., 2023; Candan & Başaran, 2023; Cheng et al., 2023; Fanshawe et al., 2020; Huang et al., 2020; Kyewski & Krämer, 2018; Sun & Sailer, 2025). Second, this study integrated the social cognitive theory and the goal-setting theory to explain the effects of gamified formative feedback on academic performance, online engagement and online self-regulated learning. Prior studies have not used the two theories to explain its effects (Li et al., 2024). Third, this study also contributes to the design and development of gamified formative feedback. An application called "LearnEnglish" was developed and designed by integrating the gamification elements (Toda, Klock, et al., 2019) into the feedback principle (Johnson & Marraffino, 2021). This integration was examined to investigate the effects of gamified formative feedback on students' academic performance, online engagement, and online self-regulated learning.

1.3 Preliminary Investigation

In the current study, a preliminary investigation was conducted before commencing the actual study to identify any problems that students face while studying English as a foreign language (EFL) at secondary schools. The researcher attempted to find out the learning challenges that secondary students face while studying English in Oman. To achieve this purpose, semi-structured interviews were conducted to identify the skills students find most challenging to acquire in an EFL context in Oman, the problems they encounter while using online platforms such as educational applications, and the issues that might deter students from using these platforms. As preparation for the interviews, some questions were set up for the students and teachers to answer, and they were allowed to speak aloud any ideas that came to their minds while being interviewed (see Appendix A). When employing semi-structured interviews, invaluable information can be collected from the students on their most difficult skills in EFL, their behaviours while using educational applications, and their opinions about formative assessment and formative feedback, whether in classrooms or on online platforms. The researcher has chosen semi-structured interviews because they offer the advantage of gaining invaluable information from both the interviewees and the interviewer, and allow for mutual communication between the students and the interviewees, thereby permitting a complete and comfortable discussion. Moreover, the qualitative method may be more suitable than quantitative methods for preliminary investigations, as it allows researchers to gain more in-depth insights into the phenomenon and ensure that students respond candidly to their questions.

One-to-one semi-structured interviews were implemented in the current study with eight students who are in grade ten at a government school. One-to-one semi-structured interviews were used because students can feel comfortable when they describe their experience and answer the questions. Furthermore, semi-structured interviews were conducted with English teachers who teach grade ten and those who utilize online platforms, such as educational applications, to deliver quizzes and activities. For the preliminary investigation, the researcher sent five questions to ten English teachers who have taught at secondary schools for more than ten years. These interviews aim to gather in-depth knowledge about the challenges participants face when posting activities on the platforms and their suggestions for overcoming these issues.

Grade ten students identified various obstacles and difficulties they encounter while learning EFL, both in face-to-face sessions and when their teachers assign activities and quizzes related to the lessons on the platforms. The interviewed students stated that they feel bored with the subject matter and are reluctant to participate in these activities, particularly when answering quizzes in the classroom. This issue becomes more apparent when students struggle to learn English grammar rules, resulting in low marks in the grammar section of the final exam. This issue is more problematic when teachers send activities through the educational applications. Students reported that there are no incentives to perform the activities that are sent on the platforms. Based on one of the students' responses, English teachers send questions on the platforms, but the explanations for why answers are correct or incorrect are not provided. Therefore, they felt hesitant to complete the tasks and activities on the platform. In a similar vein, teachers complained that few students participate in the platforms and they do not answer the questions most of the time.

Some of the interviewed students also reported that the formative assessment activities they receive in the classroom do not encourage students to continue answering questions because they consider this practice a conventional method of assessment. Teachers sometimes take one week to give students their marks for their formative assessment activities because some of these teachers teach more than four classes, which are composed of more than 120 students in total. Some of the students suggested that formative assessment should be done online for easy access and instant feedback. Moreover, students who receive formative assessment in educational applications stated that they do not have sufficient time to do the formative assessment activities at home, and the place where they study is not convenient to do their tasks comfortably. Therefore, they believe that this kind of task adds to their workload and is not beneficial for their learning. These types of skills are related to some self-regulation skills and students may not be able to master them using regular learning activities. Some students noted that, although some English teachers use Quizziz and Kahoot applications to provide interesting tasks, the fast-paced nature of the questions makes it challenging to grasp grammar rules. Students must answer quickly without considering whether their answers are correct or not. By the end of the quiz sessions in Quizziz and Kahoot applications, students complained that they did not benefit from the questions and considered them useless activities. In addition, some students noted that teachers assign tasks through educational applications without explaining their purpose or the relevant grammar rules. Sometimes, several grammar rules are mixed in one task so that it is difficult to distinguish which questions belong to which grammar rules. Furthermore, they stated that some teachers request students to do homework and execute formative assessment assignments without providing guidelines at the beginning of the tasks. This could be attributed to the learning

outcomes and the necessity of providing them at the outset of the task to ensure a clear understanding of the tasks.

Regarding the responses from the interviewed teachers, most of them posited that students' engagement in the learning process is a challenge that English language teachers face when they teach face-to-face or post activities online. About 70% of the interviewed teachers (seven teachers) confirmed that attempting to engage EFL learners in the learning process is a problem that teachers might face. Therefore, some solutions should be proposed to solve this problem. Likewise, 70% of the interviewed teachers also claimed that students do not engage with the learning materials and assessment activities when posted in educational applications. The teachers identified several obstacles to engagement in the learning and formative assessment process, including inadequate Internet connectivity, insufficient feedback, lack of continuous practice, limited digital knowledge of the platform, and low motivation to learn English as a foreign language.

The researcher used a thematic analysis to code and categorize the gathered data from the semi-structured interviews. The purpose of the thematic analysis is to explore the major themes and concepts that have been mentioned in the semi-structured interviews. The themes identified in the analysis include online learning, effective feedback, personal skills, and learning materials. According to the thematic analysis results, the themes that should be focused on to address low online engagement and a lack of online self-regulation skills among grade ten students could impede the learning process, potentially leading to low academic performance levels.

Overall, the preliminary investigation revealed that many difficulties and obstacles face grade ten students at secondary schools, which can affect their

performance in English exam scores. The lack of suitable feedback about students' responses and the limitations of traditional formative assessment methods are hindering the new advancements in the digital era. Considering the increasing need for students' engagement in the learning and assessment process, as well as the requirement for online self-regulated learning skills among secondary government students, it is essential to integrate formative feedback, particularly through explanatory electronic feedback, to address any misconceptions in learned concepts. Consequently, by emphasizing gamified explanatory formative e-assessment feedback, this study aims to enhance students' online engagement and support self-regulated online learning, thereby improving students' academic performance.

1.4 Statement of the Problem

Generally speaking, language proficiency for English language learners is too low when they study English as a foreign language (Getie, 2020). Research indicates that English language proficiency is often low among English language learners in non-English-speaking countries (Eva et al., 2022; Kithinji & OHirsi, 2022). Factors causing this include ineffective teaching, inadequate curricula, lack of interest, limited exposure to English outside the classroom, and unsupportive parents (Lai et al., 2024; Yassin & Abugohar, 2022). These challenges highlight the need for improved teaching methods, curricula, and supported systems to enhance English language proficiency among learners. Omani learners are not exceptional because they do not practice what they study outside the classroom, especially when they study at government schools (Mudhsh et al., 2023; Naqvi et al., 2023). Therefore, the Omani Ministry of Education constituted a committee to investigate the potential factors that led to these bad results. One of the decisions of this committee was to change the format of the final exam to

meet the students' levels and to use more advanced technology to engage students in the learning process. Specifically, the grammar test was problematic for students as they do not practice what they have learned in the classroom because they learn English as a foreign language and they seldom find people to practice English with (Lin et al., 2020).

Moreover, online learning has become a dominant method of teaching in recent days in different institutions around the world (Affouneh et al., 2020; Ali, 2020) because the educational systems are preparing for any emerging situations. Online learning should supplement face-to-face teaching so that students can improve their academic performance (Detyna et al., 2023; Salmani et al., 2022). This approach may develop many cognitive, affective and behavioral skills such as motivation (Putra, 2021), students' satisfaction (Landrum et al., 2021) and higher-order thinking skills (Johansson, 2020). However, teachers and lecturers have encountered various challenges that might hinder the proper use of online learning. One of these challenges is the lack of utilization of the content materials that are assigned to students outside the classroom as homework (Aldhafeeri & Alotaibi, 2022; Zainuddin, Haruna, et al., 2019). These tasks and activities are assigned for students to answer questions online as formative assessment tools to support students in their learning; however, few students attempt to perform these tasks and activities asynchronously (Aldhafeeri & Alotaibi, 2022; Taşkın & Kılıç Çakmak, 2022). In the Omani context, when students are given quizzes or activities to answer asynchronously, they lack completion of these assignments and interaction with the materials (Mohammed et al., 2020). A study conducted in Oman to examine the students' interaction while using educational applications indicated that students were less interactive in asynchronous mode than when teachers taught the materials synchronously (Mohammed et al., 2020).

Furthermore, students typically find it challenging to organize their own duties, especially at primary and secondary school levels (Hautakangas et al., 2022; Syapira et al., 2022). Generally speaking, students typically lack online self-regulated learning when studying at home with their family, as they are often distracted by those around them (Cheema et al., 2022). For example, Said Al-Hosni et al. (2024) found that Omani students gained low scores in self-regulation in the pre-questionnaire for both groups in the study: the experimental group ($M = 3.09$, $SD = 0.19$) and the control group ($M = 3.07$, $SD = 0.26$). Similarly, Al-Duhani et al. (2024) found that Omani students scored low in self-regulation in the pre-test for both groups as well: the experimental group ($M = 3.87$, $SD = 0.44$) and the control group ($M = 3.58$, $SD = 0.66$). Moreover, some studies highlighted that even if students own specific kinds of self-regulation skills, they struggle to choose, assess and modify the inappropriate strategies (Chikwa et al., 2018; Honnurvali et al., 2022). In the Omani context, although the study was conducted at a tertiary level, the findings of this study concluded that students depend heavily on their teachers in learning the English language, and there was little inclination to rely on themselves in studying (Chikwa et al., 2018; Honnurvali et al., 2022).

Therefore, the study attempts to address the problems of low marks in students' grammar performance, lack of students' online engagement and students' difficulties in self-regulating their duties while studying online. To address these issues, researchers and scholars have proposed modern and technological techniques that can enhance students' academic performance, increase their online engagement, and promote online self-regulated learning. Examples of these technological techniques are self-generated graphics (Colliot & Jamet, 2018; Wang et al., 2021), clickers (Cline et al., 2023; Remón et al., 2017) and formative e-assessment feedback (Jiao, 2015;

Sudakova et al., 2022). However, students are reluctant to complete the activities using these strategies and technological techniques unless they are observed and monitored by their teachers because some technological techniques lack a sense of enjoyment and excitement. Gamified formative feedback might help students become more engaged in the online learning process (Huang et al., 2019; Ishaq et al., 2021; Krath et al., 2021).

Another widespread instructional method is online formative e-assessment feedback (OFEAF) (Sudakova et al., 2022). OFEAF has widely proliferated during the last decade among educational researchers and professionals due to its benefits and the dissemination of diverse technologies in schools and universities (McLaughlin & Yan, 2017; Sudakova et al., 2022). However, research indicated that students are reluctant to answer these online formative assessment activities for several reasons. The first reason is that students perceive online formative assessment as boring activities; however, when teachers integrate gaming elements into this strategy, students find that formative assessment activities become more interesting (Zhang & Crawford, 2023). The second reason is that providing online formative assessment activities for students could cause heavy cognitive load and may lead them to be overwhelmed (Du et al., 2022). Du et al. (2022) conducted a study to reveal the potential effects of online formative assessment, and they found that this strategy alone caused students to be cognitively loaded and eventually affected the students' achievement. Thus, one of the suggested types of delivery as OFEAF is the gamified assessment (GA), which is suggested to be effective in educational settings in recent years (Chu & Fowler, 2020; Zainuddin, 2018). In the English as a foreign language (EFL) or English as a second language (ESL) context, many studies employed digital gamification to teach English language content (Dehghanzadeh et al., 2021). This method may improve some language skills such as writing (Zhihao & Zhonggen, 2022), reading (Li & Chu, 2021;

Qiao et al., 2022), and vocabulary (Cao et al., 2022). Previous studies examined the gamified questions and quizzes on learning grammar (Hong et al., 2020; Mimouni, 2022; Purgina et al., 2020). However, the current study attempted to add to the literature about the gamified formative feedback and assessment on grammar learning.

The above-mentioned studies investigated how gamification can be used while learning English skills in the classroom. However, few studies have addressed how the gamified e-assessment feedback as a formative tool can help students in their learning outcomes when learning online outside the classroom (Chu & Fowler, 2020; Zainuddin, Shujahat, et al., 2020). The proposed study examined how gamified formative feedback helps students learn grammar when used in the formative assessment stage.

Moreover, there is a paucity of research on how gamified formative feedback can promote online self-regulated learning in secondary school education. Therefore, this study attempts to fill this lacuna by providing insights and findings regarding the issue of increasing students' online self-regulated learning (Dehghanzadeh et al., 2021). Also, some researchers suggested conducting studies to investigate the effects of gamified assessment on online self-regulated learning (Ferreira da Rocha et al., 2023; McLaughlin & Yan, 2017).

However, some studies claimed that gamified formative feedback in the formative assessment process is not sufficient alone, and it should be accompanied by other techniques to increase its effectiveness (Mimouni, 2022; Qiao et al., 2022; Tirado-Olivares et al., 2021). For example, Mimouni (2022) used class reflective feedback along with gamified formative assessment to increase students' academic achievement. Another study by Tirado-Olivares et al. (2021) employed inquiry-based

learning to increase students' engagement and promote their learning outcomes. Another study by Ferreira da Rocha et al. (2023) utilized the Open Learning Model along with gamification elements to enhance self-regulation skills for students. This technique is called explanatory feedback and it was postulated in the feedback principle of cognitive theory of multimedia (Johnson & Priest, 2014). Therefore, this study employed explanatory feedback in conjunction with a gamified formative assessment to address its primary research objectives, specifically academic performance, online engagement, and online self-regulated learning skills.

In addition, individual differences play a significant role in the development of students' cognitive, behavioral, social and emotional outcomes. These individual differences are attributed to the personal characteristics that each person owns, however, anybody could possess these characteristics, but they may differ by degree for each person (Pawlak & Kruk, 2022). These individual differences were referred to as the factors that might affect students' performance and engagement such as preferences, abilities and skills (Luo, 2023). Previous studies claimed that it is necessary to determine the students who can benefit from specific instructional methods like gamification and who do not (Luo, 2023; B. J. Morris et al., 2019). The cognitive styles, holists vs serialists, are one of these personal characteristics or individual differences that could affect students' academic performance, online engagement and online self-regulation skills while learning EFL using gamified formative e-assessment feedback (Chen & Tseng, 2021).

Regarding the research that has been conducted so far related to the proposed study, to the best of the researcher's knowledge, only a few studies have been conducted to investigate the effect of gamified e-assessment feedback on the EFL

context (Dehghanzadeh et al., 2021). The existing studies investigated the impact of game-based assessment on test anxiety, exam performance, students' learning and engagement at the tertiary level. However, rare studies in the literature have investigated whether the gamified formative feedback affects learning grammar, online engagement, and online self-regulated learning at secondary school levels in Oman.

1.5 Research Objectives

The aims of the current study are fivefold as follows:

- i. To design and develop an Android application that has two formative feedback modes: Gamified Formative feedback (GFF) and Gamified Formative Explanatory feedback (GFEEF).
- ii. To examine the effects of two formative feedback modes (GFF and GFEEF) on students' academic performance with two different cognitive styles (Holists and Serialists).
- iii. To investigate the effects of two formative feedback modes (GFF and GFEEF) on students' online engagement with two different cognitive styles (Holists and Serialists).
- iv. To examine the effects of two formative feedback modes (GFF and GFEEF) on students' online self-regulated learning with two different cognitive styles (Holists and Serialists).
- v. To propose a predictive model consisting of different potential factors (i.e., gaming experience, prior knowledge, and quiz attempts) using a data decision tree that may help students enhance their academic performance.

1.6 Research Questions

Therefore, the current study attempts to answer the following research questions:

A- What is the effect of Gamified Formative feedback (GFF and GFEF) on academic performance? The subsidiary questions for Research Question A are:

- i. Is there any significant difference in students' academic performance between the two formative feedback mode groups (GFF and GFEF)?
- ii. Is there any interaction effect between the two cognitive styles (Holists and Serialists) and the two formative feedback modes (GFF and GFEF) in students' academic performance?

B - What is the effect of Gamified Formative feedback (GFF and GFEF) on students' online engagement? The subsidiary questions for Research Question B are:

- i. Is there any significant difference in students' online engagement between the two formative feedback mode groups (GFF and GFEF)?
- ii. Is there any interaction effect between the two cognitive styles (Holists and Serialists) and the two formative feedback modes (GFF and GFEF) in students' online engagement?

C- What is the effect of Gamified Formative feedback (GFF and GFEF) on students' online self-regulated learning? The subsidiary questions for Research Question C are:

- i. Is there any significant difference in students' online self-regulated learning between the two formative feedback mode groups (GFF and GFEF)?
- ii. Is there any interaction effect between the two cognitive styles (Holists and Serialists) and the two formative feedback modes (GFF and GFEF) in students' online self-regulated learning?

D- Which potential factors (gaming experience, prior knowledge and quiz attempts) can predict the students' academic performance in the proposed predictive model while learning grammar for both groups in the current study (GFF group and GFEF group)?

1.7 Research Hypotheses

The hypotheses for this study are formulated as null hypotheses. In this research, the researcher will reject the null hypothesis when the p-value turns out to be less than the significance level, which is 0.05. The null hypotheses that correspond to the above major research questions are:

A. The effects of two formative feedback modes (GFF and GFEF) on students' academic performance. The subsidiary null hypotheses are:

H_{0.A.1} There is no significant difference in academic performance between students who received GFF and those who received GFEF.

H_{0.A.2} There is no significant difference in academic performance among students with different cognitive styles in the GFF group.

H_{0.A.3} There is no significant difference in academic performance among students with different cognitive styles in the GFEF group.

H_{0.A.4} There is no significant difference in academic performance among students with Holists' cognitive style in the GFF group and those in the GFEF group.

H_{0.A.5} There is no significant difference in academic performance among students with Serialists' cognitive style in the GFF group and those in the GFEF group.

B. The effects of two formative feedback modes (GFF and GFEF) on students' online engagement. The subsidiary null hypotheses are:

H_{0.B.1} There is no significant difference in students' online engagement between students who received GFF and those who received GFEF.

H_{0.B.2} There is no significant difference in students' online engagement among students with different cognitive styles in the GFF group.

H_{0.B.3} There is no significant difference in students' online engagement among students with different cognitive styles in the GFEF group.

H_{0.B.4} There is no significant difference in students' online engagement among students with Holists' cognitive style in the GFF group and those in the GFEF group.

H_{0.B.5} There is no significant difference in students' online engagement among students with Serialists' cognitive style in the GFF group and those in the GFEF group.

C. The effects of two formative feedback modes (GFF and GFEF) on students' online self-regulated learning. The subsidiary null hypotheses are:

H_{0.C.1} There is no significant difference in students' online self-regulated learning between students who received GFF and those who received GFEF.

H_{0.C.2} There is no significant difference in students' online self-regulated learning among students with different cognitive styles in the GFF group.

H_{0.C.3} There is no significant difference in students' online self-regulated learning among students with different cognitive styles in the GFEF group.

H_{0.C.4} There is no significant difference in students' online self-regulated learning among students with Holist's cognitive style in the GFF group and those in the GFEF group.

H_{0.C.5} There is no significant difference in students' online self-regulated learning among students with Serialists cognitive style in the GFF group and those in the GFEF group.

1.8 Research Framework

Figure 1.1 illustrates the research framework of this study. As depicted in the figure, the independent variable is gamified formative feedback. Two groups were exposed to two interventions: one was the gamified formative feedback, and the other was the gamified formative explanatory feedback. The students can answer the quizzes as a formative assessment at home. Gamified formative feedback was chosen because this instructional method is hoped to increase students' academic performance, online engagement and online self-regulated learning. However, the dependent variables are academic performance, online engagement and online self-regulated learning. The academic performance was chosen in this study because students usually gain low marks in the final exams in the grammar questions and the suggested technique is hoped to improve students' performance in this part. Students' online engagement was chosen as another dependent variable in this study because students usually do not participate or engage with the learning materials and online homework assigned by the teachers (Aldhafeeri & Alotaibi, 2022; Taşkın & Kılıç Çakmak, 2022). The gamified formative feedback may increase students' online engagement and encourage them to answer the questions effectively. The third dependent variable (Online self-regulated learning) was chosen because previous studies claimed that secondary students lack the skills of self-regulated learning (Hautakangas et al., 2022; Syapira et al., 2022) and this deficiency may affect students' willingness to do their homework and answer the questions outside the classrooms. The suggested technique in this study may solve this problem and encourage students to online self-regulate their learning. One dependent variable was measured before and after the exposure to the two types of interventions (academic performance) and two variables was measured after the intervention (students' online engagement and online self-regulated learning). The operational

definitions for the three variables are provided in section 1.13 of this chapter. In addition, the research framework contains one moderator which is cognitive styles. This moderator was used to examine the interaction effect between the independent variable (the two modes of feedback) and the dependent variables (academic performance, students' online engagement and online self-regulated learning). The cognitive styles contain two types of learners who are holists and serialists. Hence, the hypotheses that were stated in the previous section were based on the research framework of this study below.

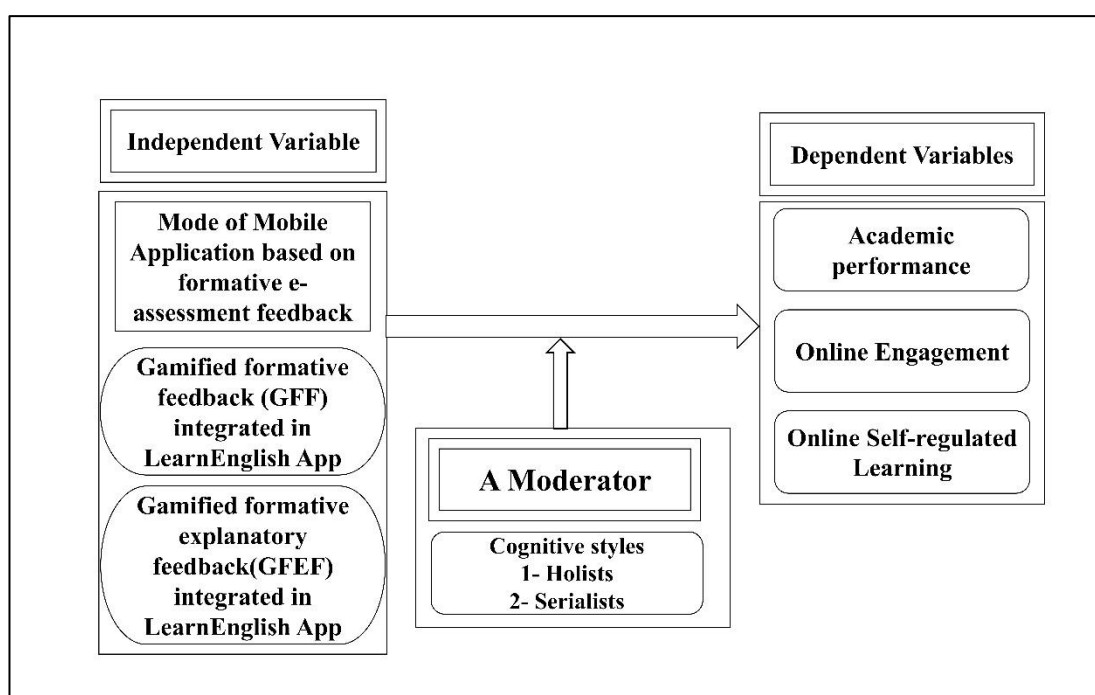


Figure 1.1 Research Framework

1.9 Theoretical Framework

Figure 1.2 below depicts the theoretical framework that is used to examine the effects of gamified formative feedback on students' academic performance, online engagement and online self-regulated learning in the classroom environment. This theoretical framework encompasses the learning theories and principles integral to this study, including the feedback principle of the cognitive theory of multimedia (Johnson

& Priest, 2014) and the gamification elements taxonomy (Toda, Klock, et al., 2019). The feedback principle and the gamification elements taxonomy were related to the independent variable and how the researcher used them to develop the application. This figure also illustrates that the feedback activities have features of formative assessment principles, such as the feedback principle and gamification elements (Black & Wiliam, 1998). The formative feedback activities refer to the post-class quizzes that contain multiple-choice questions that were posted via a developed application called LearnEnglish.

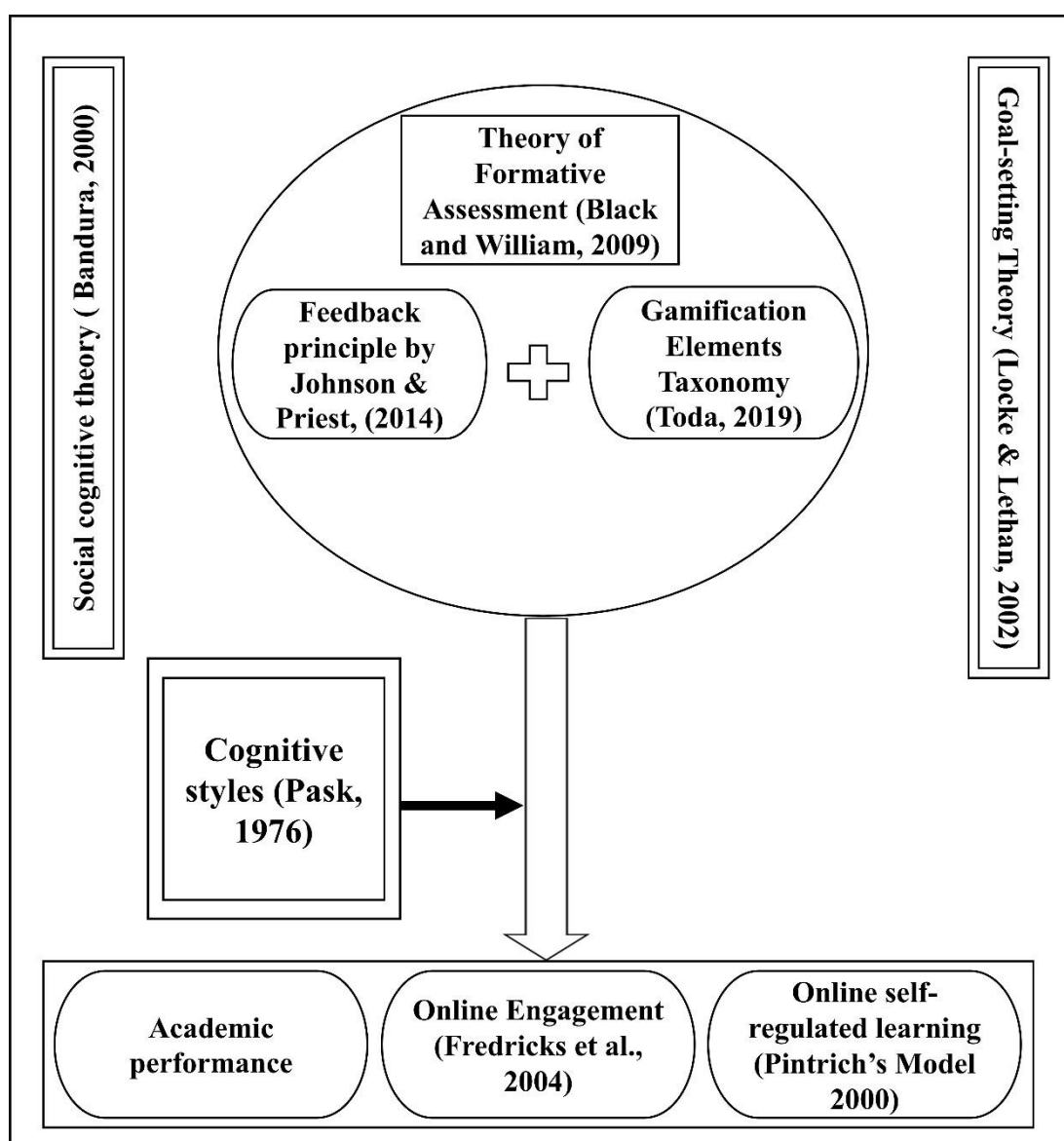


Figure 1.2 Theoretical Framework