



Effects of Scaffolding in Digital Game-Based Learning for Promoting Learners' Autonomy in Foreign Language Contexts

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Abstract

This study explores the impact of scaffolding digital game-based learning on learner autonomy in an English as a Foreign Language (EFL) context. Despite the growing interest in student-centred learning, the empirical knowledge regarding autonomy in language education, particularly in Computer-Assisted Language Learning (CALL), remains limited (Sanprasert, 2010; Chik, 2012). This research involved 64 female participants aged 20-24, who volunteered after obtaining ethical clearance. Participants engaged in autonomous out-of-class tasks, supplemented by group and pair work to foster interaction and cooperation. Pre- and post-surveys were administered to assess changes in learner autonomy, utilizing longitudinal data analysis for multiple measurements over time. Additionally, group interviews were conducted to gain further insights into the participants' experiences. Findings indicate the effectiveness of game-based learning in enhancing learner autonomy outside traditional classroom settings.

Keywords: Digital Game-Based Learning, Learner Autonomy, EFL Context, Computer-Assisted Language Learning (CALL)

Introduction

A rising number of L2 educators in the field of computer assisted language learning (CALL) have focused on informal language acquisition and the role of agency in digital literacies as a result of the changing ecological conditions of learning and instruction. Informal learning is directly linked to several 21st century abilities (Voogt & Pareja Roblin, 2012). Informal, usually interest-driven learning environments require a variety of communication and teamwork skills, problem-solving abilities, information literacy and critical thinking abilities, as well as proficiency in information and communication technology. In the 21st century, the ability to seek information and learn informally is essential for language learning (Redecker et al., 2011).

According to Lee (2019), informal learning refers to 'self-directed, self-instructed, digital learning of English in semi-structured, out-of-class environments that are still linked to a formal language program' (p. 115). Godwin-Jones (2019) emphasised that the future of English Language Teaching—and language learning and teaching in general—would be shaped by digital technologies for learning beyond the classroom. Understanding how informal digital learning environments can foster learner autonomy has important implications for the design of effective educational practices that empower learners to become self-directed and lifelong learners. Moreover, recognising the impact of learner autonomy within informal digital learning contexts informs the development of digital learning resources, tools and platforms that cater to learners' diverse needs, interests and learning styles.

An extensive amount of literature has shown that contemporary English learners practice digital informal learning by utilising a range of online materials and communities. However, there is a lack of longitudinal studies examining the development of learner autonomy within informal digital learning contexts over an extended period in the English as a Foreign Language (EFL) context. Such studies would provide insights into the long-term effects of informal digital learning on learner autonomy and how it evolves over time (Chik, 2012), investigating the challenges that students face in building their autonomy outside the learning environment, especially in a foreign language context where language exposure is limited. Sanprasert (2010) stated, "the empirical knowledge base on autonomy in language education in relation to CALL [...] remains somewhat weak" (p. 209). In particular, the exercise of autonomy in an out-of-class language learning context is a relatively underexplored area (Chik, 2012). Further research is needed to explore how teachers can effectively support and scaffold learner autonomy within informal digital learning environments as well as the most effective pedagogical approaches to facilitate this process.



The aim of this study was to assess the impact of scaffolding informal digital learning through game-based learning on learner autonomy within EFL context. Specifically, this study sought to evaluate the efficacy of promoting autonomous out-of-class study through informal digital learning. The outcomes of this research contribute to a continuous improvement cycle in instructional practices, learner-centred approaches and the development of autonomous learners. By applying the insights gained from research, educators can create more effective and engaging learning experiences that empower learners to become self-directed, lifelong learners.

This research aims to answer the following questions:

RQ1: What is the effect of digital informal learning on students' autonomy as a complement to game-based foreign language learning?

RQ2: How does technology-supported informal instruction enhance student's autonomy in cognitive, affective and sociocultural-interactive strategies?

Methodology

Research Design

The study employed a mixed-methods longitudinal design to assess the impact of informal digital -based learning on students' autonomy, as well as the barriers students navigate to develop this autonomy. The experiment lasted for 15 weeks. First, it assessed the effectiveness of providing autonomous out-of-class game-based tasks through a questionnaire administered before and after the intervention, examining learners' strategic self-regulation: cognitive strategies, affective strategies, and sociocultural-interactive strategies. Data analysis involved paired samples t-tests to compare pre-test and post-test scores. Second, the study investigated how game-supported informal instruction enhanced student autonomy. A group interview was conducted to examine these factors, and thematic analysis was used to code these data. Ethical considerations and participant confidentiality were maintained throughout the study. The digital game utilized in this study is Kahoot an interactive learning platform designed to engage students through gamified quizzes and assessments. This tool facilitates collaborative learning.

Participants and Setting

A total of 64 female participants aged 20-24 were recruited as volunteers for this study. These participants willingly agreed to participate and provided informed consent, acknowledging that their involvement would not impact their course grades. The study was conducted within the context of an English course offered by the English Language Institute at a prominent public university. The university served as the setting for data collection, offering a suitable environment for assessing the impact of scaffolding in digital game-based learning and the stumbling blocks students overcome in their journey towards independence in an EFL educational context.

Data Collection

Questionnaire on Perception of Learning Autonomy

To assess the learners' perceived level of autonomy before and after the intervention, the researcher designed a questionnaire. The design was based on Oxford's (2011) identification of three factors of strategic self-regulation: cognitive, affective, and sociocultural-interactive strategies. In addition to cognitive strategies, emotional strategies were incorporated to gain insights into students' understanding of their own and others' emotional states. This approach emphasizes the recognition, comprehension, and utilization of emotional information within a digital informal learning community. This is pertinent because the students' exposure to English was limited, and communication usually occurred in settings where learners were more interested in communicating with peers rather than for educational purposes (Reeve, 2006).

Cognitive strategies enhance a learner's ability to process information deeply, transfer it to new situations, and improve retention (Winn et al., 2019, p. 6). They encompass reasoning and metacognitive abilities, including evaluating educational necessities, examining academic advancement, and critical thinking (Jeong, 2018, p. 15). These strategies are important to establish, encode, and review data; use metacognitive approaches to evaluate knowledge and the learning



process; guide accomplishment; achieve effective time management; create a constructive work setting; and utilize resources efficiently.

Pintrich (2000b) described three phases of cognitive self-regulated strategies that were added as elements to the questionnaire: preparation, performance, and appraisal. The preparation phase includes task descriptions, organization, setting objectives, task evaluations, approach choice, and choice of viewpoints, such as self-efficacy, result anticipation, appreciation, and internal motivation. The performance phase involves target attempts, approach utilization, strategy supervision, modification of self-training, concentration of effort, self-documenting, and self-monitoring. The appraisal stage relates to consequent alterations in planning, accomplishment, and appraisal, in a recurrent sequence.

The affective dimension is associated with the extent of learners' involvement in and their affective responses to the learning tasks (Liaw et al., 2007). The aspects included were centered on the five stages of Krathwohl's (1964) affective domain taxonomy, from smallest to largest: (1) active engagement (receiving); (2) reacting (responding); (3) appreciating (valuing); (4) orderliness (organization); and (5) classification (characterization by a value or value complex).

The final constituents of learner autonomy were sociocultural-interactive strategies dealing with communication with others, despite insufficient knowledge or a lack of interpersonal communication (Patrick & Middleton, 2023). In the case of online learning, where combined and social technology plays a crucial role, learners have the opportunity to engage with colleagues, cooperate on educational assignments and jointly traverse the educational method. Therefore, learners can take responsibility for their education, make individual choices and dynamically influence the group's knowledge environment.

Group Interview

In this study, a semi-structured group interview approach was employed, allowing for open-ended questions that facilitated two-way communication. This approach encourages reciprocal interactions between the interviewer and participants, enabling the interviewer to adapt and formulate follow-up questions based on the participants' responses (Kallio et al., 2016). It provides a platform for participants to express their individual perspectives and experiences verbally. As Rabiee (2004) noted, group interviews are data-rich, flexible, stimulating for respondents, aid in recall and lead to cumulative and elaborative discussions beyond individual responses. The utilisation of a group interview format aligns with the aim of gathering in-depth and rich data concerning the obstacles students confront to foster their independence and the strategies they use to overcome these obstacles.

Procedure

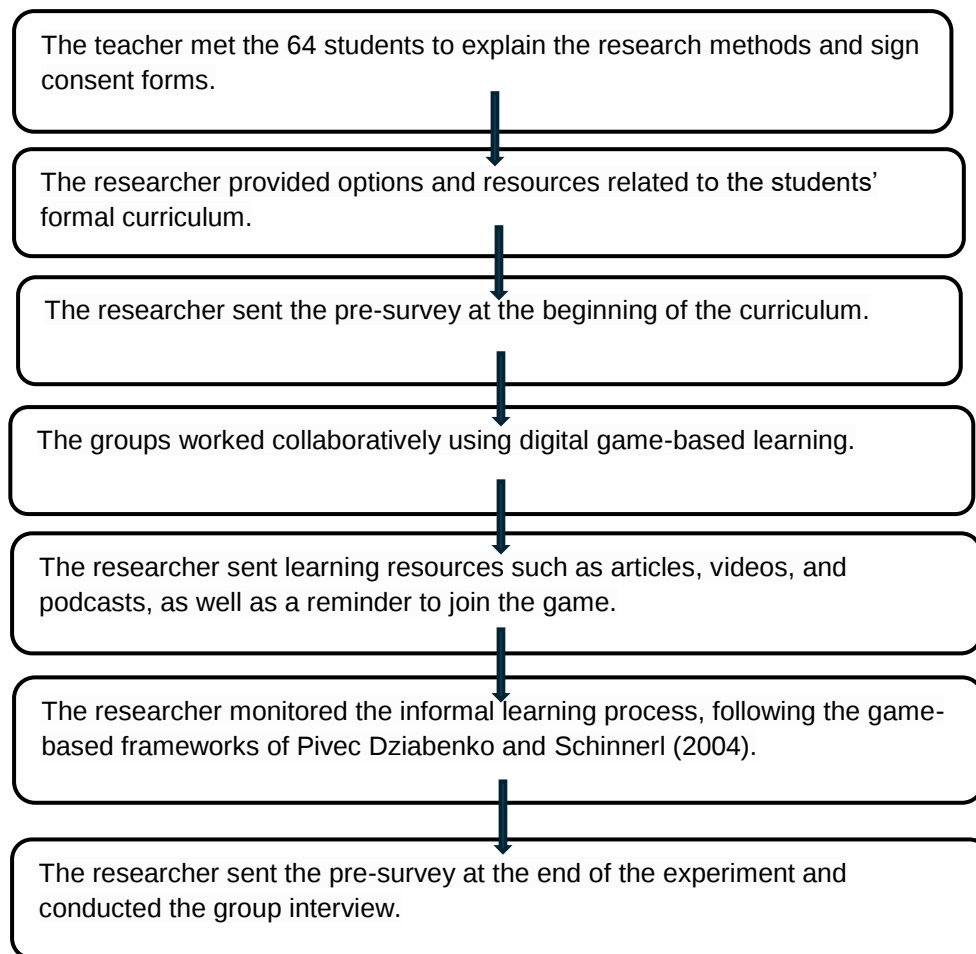
The researcher obtained ethical clearance from the university where the participants were invited to participate as volunteers. A total of 64 agreed to participate and signed consent forms in which it was acknowledged that their participation would not affect their course grades. The researcher first sent links to the pre-survey during the initial use of the application and the post-survey at the end of the experiment. This longitudinal data analysis, involving multiple measurements of the same variables over a period of time, was used to measure and investigate any changes in the participants' responses during the experiment. The researchers concluded the group interview at the end of the experiment, dividing the students into five groups.

Pedagogical Methodology of Integrating Informal Learning in Digital Game-Based Learning

The duration of this course was four months. Each week, the students were required to use the digital game outside the classroom. The students were divided into groups. Each group consisted of five students, working collaboratively. Each week, the teachers followed the framework shown in Figure 1.



Fig. 1. Pedagogical Methodology of Integrating Informal Learning in Digital Game-Based Learning



***The Game-Based Framework of Pivec Dziabenko and Schinnerl (2004)
Determining the Pedagogical Approach***

In this stage, the focus was on the instructional design of tasks aligned with the learning objectives of the students' curricula. Key concepts and skills that students needed to learn were identified. The selected game supported learning outcomes by incorporating pedagogical principles such as feedback, assessment, and scaffolding, ensuring a challenging and engaging learning experience.

Implementing and Situating the Task in a Game Environment

In this step, the researcher created various informal materials, including extra-curricular, non-formal, and co-curricular activities, considered part of a lifelong learning process through diverse experiences. Non-formal education specifically refers to organized educational activities outside the formal school framework (Gross & Rutland, 2017, p. 3). These tasks complement formal learning by providing real-life contexts, authentic materials, and practical application opportunities, thereby enhancing reading knowledge and skills (see Table 1).

Students practiced skills such as comprehension, critical thinking, analyzing situations, evaluating options, and making choices, while also activating reading techniques like skimming and scanning and expanding their vocabulary. The design tasks were engaging and meaningful, helping students comprehend texts in real-world contexts.

The chosen topics were based on the main themes of the students' reading curricula. The researcher selected five themes and collaborated with five language teachers to modify tasks according to students' proficiency levels and learning objectives. This collaboration provided a holistic view of instructional design that addressed the diverse needs of students, positively influencing their motivation and catering to their prior knowledge.



The activities consisted of two parts. The first part included vocabulary exercises, website links, and YouTube videos related to the reading passages, offering definitions and pronunciation for uncommon vocabulary. The second part comprised reading passages and comprehension tests where students practiced and applied strategies such as skimming, predicting, inferencing, and summarizing. The author informed participants that the informal tasks facilitated self-directed English learning using digital devices, providing students with choices and decision-making opportunities. The researcher scaffolded strategies to promote autonomy, encouraging self-direction and independence.

Table 1. Weekly Topics and Task Objectives for Digital Game-Based Learning Tasks

Week No.	Topic	Task Objectives
Weeks 1 & 2	Social Relationships	This task emphasized enhancing interpersonal and social skills, differentiating between nonverbal and verbal communication and relating it to students' own lives, and considering how the themes and dynamics of social relationships resonate with their own experiences.
Weeks 3 & 4	Working Together	The reading task aimed to encourage critical thinking to increase the complexity of working as a team, understanding diverse perspectives and applying effective communications to achieve the teams' goals.
Weeks 5 & 6	Language and Culture	The aim of the reading task was to identify cultural appropriation and understanding different representations of cultural voices that contribute to authenticity of culture and people's identities.
Weeks 7 & 8	Human Impacts on the Environment	The task aimed to examine humans' actions towards the environment and their effects on environmental degradation, such as pollution, bush fires, deforestation and climate change.
Weeks 9 & 10	Healthy Habits	The aim of the task was to empower the students' literacy in relation to their health habits, increasing their awareness of empirically supported practices and pseudoscience.

Elaborating the Details and Incorporating Underlying Pedagogical Support

The researcher elaborated on the details of the game, including the game mechanics, rules and learning objectives. This ensured that the chosen technology and designed reading tasks were challenging and engaging while still supporting the desired learning outcomes. As previously mentioned, the researchers supplied students with various informal materials.

Assessment and feedback are pedagogical supports that are an important part of digital informal learning. This may involve using immediate feedback that is built into the game. This step involved integrating pedagogical support such as feedback, hints and scaffolding into the game. These processes can help learners stay on track and provide guidance as needed without detracting from the overall gaming experience (Safatian, 2023).

To add another form of feedback, the researcher emphasised the learning community by creating a discussion panel on Blackboard. This helped the students ask questions, provide assistance and feedback to each other as a channel to negotiate, and engage in learner-to-learner and learner-to-instructor interaction. This step promoted reflection, collaborative learning, and increased autonomy, offering opportunities for social interaction and collaboration among players. Learners could engage in cooperative tasks, exchange ideas, and receive peer feedback, allowing



them to process and internalize the text at their own pace, which led to the development of reflective learning.

Map Learning Activities to Interface Actions and Interface Objects

In this step, the learning activities were mapped to specific actions within the game interface. This ensures that the learning objectives are aligned with the game and that the interface is intuitive and easy to use. It is most effective when it is integrated into the larger curriculum. This involves integrating game-based learning into lesson plans and activities in a way that complements existing teaching methods and ensures that game-based learning is not viewed as a separate or isolated activity. Finally, the designer mapped the learning concepts to specific objects within the game interface. This helps learners understand the relationship between the learning objectives and the game mechanics, enabling them to apply what they have learned in the game to real-world situations.

Data Analysis

The data analysis plan for this study encompassed both quantitative and qualitative methods to comprehensively address the research questions and provide a robust understanding of the research objectives. For the quantitative component, paired samples T-tests were conducted to assess changes in participants' perceived levels of autonomy, specific strategies, autonomous behaviours, independence and confidence before and after the intervention involving autonomous out-of-class game-based tasks. This analysis provides insights into the effectiveness of the intervention and its impact on learner autonomy.

In the qualitative component, the data gathered through the group interview were analysed thematically to uncover recurring themes and patterns within participants' opinions of the challenges they faced. This qualitative analysis provides in-depth insights into the participants' experiences and perspectives.

Results

RQ1: What is the effect of digital informal learning on students' autonomy as a complement to game-based foreign language learning?

Table 2. Comparison of Pre-Test and Post-Test Means and Standards Across Dimensions

Dimension	Pre-Test Mean (SD)	Post-Test Mean (SD)
Metacognitive	3.10 (0.65)	4.20 (0.58)
Cognitive	2.90 (0.70)	4.05 (0.62)
Meta-affective	3.25 (0.55)	4.35 (0.50)
Meta-sociocultural-interactive	3.00 (0.75)	4.15 (0.65)

These findings demonstrate that students achieved greater levels of autonomy in various areas after the intervention (See Table 2). Within the metacognitive dimension, the mean score rose upon testing from 3.10 (SD = 0.65) to 4.20 (SD = 0.58), $t\text{-test} = -10.67$ ($p = .001$), and a large value of Cohen's $d = 1.10$, which represents greater planning and summarisation. The cognitive dimension had score increases with a $t\text{-value}$ of -9.54 ($p < .001$) and a huge magnitude of effect (Cohen's $d = 0.95$), which indicates a better approach to vocabulary acquisition. The meta-affective dimension increased from 3.25 (SD = 0.55) to 4.35 (SD = 0.50), with a $t\text{-value}$ of -11.24 ($p < .001$), accompanied by a very high effect size (Cohen's $d = 1.15$), indicating a better approach to emotionality and motivation. Finally, the meta-sociocultural-interactive dimension improved from 3.00 (SD = 0.75) to 4.15 (SD = 0.65), with a $t\text{-value}$ of -8.92 ($p < .001$) and a moderate to large effect size (Cohen's $d = 0.88$), which indicates improvements in cultural awareness and peer interactions. Overall, the intervention was effective in encouraging the autonomy of students in the aforementioned dimensions.

Paired Samples T-Test Results

Table 3 presents the results of the paired samples $t\text{-test}$, which compares pre-test and post-test scores for each dimension.



Table 3. Statistical Analysis of Metacognitive Dimensions and Their Effect Sizes

Dimension	t-value	p-value	Cohen's d
Metacognitive	-10.67	< .001	1.10
Cognitive	-9.54	< .001	0.95
Meta-affective	-11.24	< .001	1.15
Meta-sociocultural- interactive	-8.92	< .001	0.88

RQ2: How does technology-supported informal instruction enhance student autonomy in cognitive, affective and sociocultural-interactive strategies?

Metacognitive Development

Informal instruction involving the use of technology had a significant impact on the students' metacognitive skills. The learners were more conscious of their learning processes as they were exposed to technology-aided activities. The researcher supported and explained the objectives of the research to the students, enabling them to contemplate their learning strategies. This form of reflection helps students assess their knowledge and modify their methods, and it creates a sense of ownership concerning the development of their own learning. One of the students explained that prior to using these tools, 'I had never imagined that I could control my learning so much'.

Cognitive Engagement

The use of technology in informal learning also facilitates the development of cognition through the interactive and arousing nature of learning. The researcher created a setting in which students could use their knowledge in a practice environment by logging into educational games and completing challenges. This practical technique not only reinforced their knowledge but also improved their critical thinking and problem-solving. Students had to ponder the content as they went through these challenges, and this resulted in a deeper understanding of the subject matter. As one student noted, 'I felt that I was not only answering questions but solving real problems as well'.

Meta-Affective Growth

The role of technology should not be underestimated in the emotional and motivational support of students. Informal instruction gave learners a sense of accomplishment as they learned in a gamified setting. This reinforcement was positive and helped them in their self-efficacy and motivation. The way the researcher presented clear goals enabled the students to set attainable goals, thereby developing a growth mentality. One of the students said, 'Completing challenges helped me feel proud and more confident in my abilities'.

Meta-Sociocultural-Interactive Competence

Finally, meta-sociocultural-interactive skills were enabled by the use of technology between students. Working on classes with peers promoted communication and teamwork, which are critical skills in a globalised world. When students collaborate, solve problems and exchange ideas, this allows them to form a feeling of trust and connection. The collaborative nature of responsibilities developed by the researcher helped to eliminate cultural and social barriers and encourage collective learning. One of the participants said that these games helped the student's bond with their classmates and learn about each other.

Conclusion

The benefits of establishing autonomy facilitated by technology-based informal teaching have significant ramifications. When emphasising the metacognitive, cognitive, meta-affective and meta-sociocultural-interactive dimensions, students can both improve their academic performance and feel a sense of agency over their learning. When they approach challenges in a supportive setting, they become more independent learners who are not afraid to face subsequent academic challenges.



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