Vocabulary acquisition in adults with dyslexia

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Abstract

This case study design aims to explore the effect of multimedia-integrated game-based learning on an adult dyslexic learner's vocabulary development and retention, sixteen weeks after an intervention. The study contributes to the gap in the literature for English as a Foreign Language in adults with dyslexia in a university context by pinpointing differences in vocabulary retention in long-term memory. In the study, the learner's retention of the previously learned vocabulary is evaluated, and 50 new words are introduced under the three new themes over three weeks. The results highlighted an increase in vocabulary acquisition and retention, which pointed out that game-based learning has a positive effect on the language development of adult learners with dyslexia.

Keywords: Dyslexia; game-based learning; language development; long-term memory; vocabulary retention

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1. Introduction

Dyslexia, also known as reading disorder, is characterized by trouble with reading despite normal intelligence (Siegel, 2006; Tarjiah et al., 2023). Dyslexia is the most common learning disability and occurs in all areas of the world. While dyslexia is more often diagnosed in men, (Peterson and Pennington, 2012), it has been suggested that it affects men and women equally in 3–7% of the population (Umphred and Lazaro, 2013). According to Turkey's Dyslexia Association, individuals with special needs compose almost 12.29% of the total population in Turkey, and most remain undiagnosed (ERG & TOHUM, 2011). Problems may include difficulties in spelling words, reading quickly, writing words, "sounding out" words in the head, pronouncing words when reading aloud, and understanding what one reads (Siegel, 2006). Nevertheless, people with this disorder have a desire to learn. Often, their difficulties are first noticed at school (Peterson & Pennington, 2012). The importance of the problem derives from the fact that when a disability goes undiagnosed, it causes difficulty in dealing with learning obstacles such as lagging behind their peers in obtaining skills and even acquiring less vocabulary than their peers (Simmons & Kameenui, 1990).

Vocabulary knowledge is the single most important factor contributing to reading comprehension and academic success (Peeples et al., 2019). There is a need for students with learning disabilities to retain vocabulary to comprehend content areas (Bos & Anders, 1990; O'Connor et al., 2015). Treatment involves adjusting teaching methods to meet the learner's needs. To adjust effective teaching methods to learners' needs that are aimed at allowing reading comprehension and academic success, the reasoning behind vocabulary insufficiency in literature is explored (Fokides et al., 2019; Farghaly et al., 2022). According to the literature, memory difficulties in learning disabilities impair the ability to retain previously learned new words (Gathercole et al., 2008; Hamouda & El-Shafaei 2021).

1.1. Theoretical background

Theories constitute a fundamental part of designing instruction. The designed tool for retention with multimedia-integrated game-based learning is developed on the following learning theories that describe its framework:

1.1.1. Mayer's principle of multimedia design

Mayer's principle of multimedia design is important in the designing of instructional materials since, when done according to a stated set of rules, multimedia support results in better student learning (Clark & Mayer, 2023). For example, Issa et al. (2011) indicate that when the content for medical students is prepared according to these principles, it improves students' short-term retention.

1.1.2. Game-based learning

The majority of definitions of game-based learning focus on the fact that it is a kind of gameplay with clear learning objectives (Shaffer et al., 2005; Udeozor et al., 2023; Gyaurov et al., 2022). The assumption is frequently made that the game is digital; however, this isn't always true. This definition's corollary states that when designing educational games, designers must strike a balance between the desire to prioritize gameplay and the need to cover the subject matter (Plass et al., 2010; Gómez & Suárez 2021; Marín-Díaz et al., 2019).

In the study, it is expected to be identified if game-based learning based on Mayer's multimedia principle develops vocabulary acquisition and if it is effective in retaining basic concepts in an adult dyslexic learner's very long-term memory; and find out if it is possible to increase the learner's vocabulary acquisition via game-based learning for three consecutive weeks in a certain limited time with a certain number of vocabulary items, the same as the number of items presented to non-dyslexic learners.

1.2. Purpose of study

In adjusting teaching methods to meet learners' needs for acquiring new vocabulary and preventing forgetting, a playful design of instruction based on repetitive patterns and characteristics

of game-based learning, which is one of the effective learning methods for improving focus, engagement, motivation, and retention used in education, is developed at the first phase of this study to enable the learner to acquire a pre-defined number of vocabularies in a given time. The first phase of this study resulted in a considerable gain in vocabulary acquisition. This study, which constitutes the second phase, explores a question related to very long-term memory in the field of memory research: "Is it possible to acquire certain numbers of vocabulary words for three consecutive weeks on different themes with mild dyslexia and retain them over the sixteen weeks after the intervention with game-based learning?" The hypothesis of the study is in line with the work that was conducted well over a century ago by Ebbinghaus (1885–1964, reviewed in Anderson, 2000), who determined that forgetting (retention curve) is initially rapid but then continues at a decreasing rate (negative acceleration).

2. Materials and Methods
2.1 Participants

The participant in this study is a single adult who is a mildly dyslexic learner and is 35 years old. She was not able to proceed with her second Bachelor of Arts in Public Relations because her vocabulary acquisition and memorization skills hindered her ability to acquire vocabulary. As a student of foreign language at Bahçeşehir University, at the School of Foreign Languages, English Preparatory Program (BAU PREP), the learner is facing problems in vocabulary acquisition. The vocabulary acquisition and memorization (recalling) skills of a mildly dyslexic learner were hindering her ability to keep up with the requirements of the English reading curriculum. The dyslexic learner is not able to recall and state 55 English vocabulary items in a week based on specific themes of reading texts. This is the second time she is doing her Bachelors in Arts; At her previous university, the medium of instruction was Turkish, so she started to learn English at Bahçeşehir University. Bahçeşehir University is an English-medium educational institution. That means all undergraduate students are required to complete the English Preparatory Program successfully. All students are required to take the English Placement Exam that is given during the registration period. Bahcesehir University has a modular system, and there are four levels (A1-A2-B1-B2). Each module is eight weeks, and to move on from one level to another, the student has to have a minimum passing grade of 65 (sixty-five) out of 100. After completing the B2 level, all students take the English Proficiency Exam, and the minimum passing grade required is 60 (sixty) out of 100.

2.2 Research method

In this study, the Design and Development Research (DBR) methodology (Richey and Klein, 2014) was used. The framework of the DBR model is comprised of six steps: (1) Identifying the problem, (2) describing the objectives, (3) designing and developing the prototype, (4) testing the prototype, (5) evaluating the testing results, and (6) communicating the testing results. While the first step of the DBR model was completed in the first phase of a previous study to develop an instructional design to enable the learner to acquire a pre-defined number of vocabulary items in a given time, the last five steps were completed in the second phase and in the scope of this study, which aims to investigate how well vocabulary knowledge is retained by the mildly dyslexic learner over the weeks and months after completing one particular game-based learning.

2.3 Data Collection Tools

2.4.1 Semi-structured interviews

A significant amount of data is provided from semi-structured one-on-one interviews held with the participant in three subsequent but separate periods lasting five hours in total, followed by transcription and preparation for data analysis. The interview questions were constructed based on the case study, involving in-depth analysis of particular experiences, perceptions, and emotions that link indications of her dyslexic world. Five-hour-long interviews with the participant provided deep insights into her attitude and self-perceptions towards learning English. The first interview focused on

the participant's general views on language learning history, attitudes toward learning English, impressions of and attitudes toward university English classes, and attitudes toward communication in English. The teacher presented information about the participant as a student in the second interview. The third data collection tool assessed the participant's level of anxiety about learning a foreign language.

2.4.2 Pre-tests and post-tests

Each week, learners were given a test for vocabulary development. The tests are specifically designed by a panel of experts consisting of testing assessment unit members, level coordinators, and one subject matter expert (teacher) of the faculty who are working on the validity of the test. The goal of the assessment test is to measure the vocabulary acquisition before and after the instruction. Tests were composed of twenty questions on English vocabulary on weekly themes of design and personality, out of 55 words that are presented in a week. Twenty questions were asked in each of the following categories: (1) completing the sentence by filling in the blanks with the appropriate word. (2) choosing a word from the list and matching it to its definition (3) matching the word with its synonym and antonym. (4) writing the correct form of the word.

2.4.3 Retention test

To measure a relatively permanent change in performance, a retention test was given to the learner. The retention test in this study refers to a test on the same material, which is "Vocabulary on Design," given after sixteen weeks of absence from practice.

2.5 Procedure

A memory game is designed for repetition based on printed flashcards, which have a picture on one side and a word and its synonym on the reverse side. The game is played after the words are practiced with spaced repetition. The game is played against one or more competitors by mixing up the cards and laying the picture side on top and the word and its synonym on the bottom in rows. The play starts with a roll of the dice; the player who rolls the biggest number starts the game. Anyone who can say the word or its synonym by looking at the picture gets to keep the card. If it is not guessed correctly, then it is turned back over. To gain an advantage over their opponent, players should try to remember what was on each card and watch and remember during the other player's turn. The game is over when all cards have been collected. The person who has the most cards wins the game.

The learner's desired learning outcome is to recall and state (acquire) approximately fifty new and unfamiliar words correctly chunked under a different theme each week. The measurement of the correctly acquired words together with the long-term retention of the previously presented words will be made in weekly achievement tests. The procedure included seven stages: (1) The learner is provided with a word list along with their definitions, synonyms, antonyms, word forms, collocations, and examples, all provided at the same table. (2) Simultaneously, the wordlist is presented on a word wall in chunks of alphabetic order at an online educational platform called 'Edublogs' which is a blog created for educational purposes and supports student and teacher learning by facilitating reflection, questioning by self and others, collaboration, and by providing contexts for engaging in higher-order thinking. (3) The learner is provided with a blog post at Edublogs explaining the reasons for building up vocabulary and the steps of pre-studying and studying instruction vocabulary in both English and Turkish. The reasons for building up vocabulary and studying steps are also explained verbally in question-and-answer format in both English and Turkish. (4) The learner is given a pre-test to identify what she knows before building her vocabulary. The pre-test is comprised of 15–20 vocabulary questions in fill-in-the-blank, match, and word formation forms. (5) The learner is given a retention test, which is a test given after an empty period without practice to identify long-term retention of her previous vocabulary acquisition study. (6) The learner is provided with a set of online flashcard practices that are designed specifically for weekly learning of the weekly vocabulary on design, personality, travel, and language themes at Quizlet, which is a mobile and web-based study application

that allows students to study information via learning tools and games. Flashcards are presented in a visual format designed by multimedia theory, with separate visual, text, and narration (sound), and presented to the learner for seven successive days of training. (7) The learner is given a weekly post-test after each theme of vocabulary learning to estimate learning by measuring the relatively permanent change in vocabulary acquisition by requiring the learner to match words with their definitions, appropriate sentence frames, antonyms, and synonyms.

2.6 Data Analysis

The collected data from interviews, pre-post, and retention tests was exposed to content analysis. Also, achievement test grades, which were developed by the university's panel of experts, were analyzed with item analysis software for internal reliability. The goal of the achievement tests is to measure skills and knowledge at a given level within the context of planned classroom instruction. The records of the grades of the dyslexic language learner were received from the testing and assessment unit of the university. The pre-post and retention tests include matching, filling in the blanks, word formation, and multiple-choice questions; all of which are by the question types in the weekly achievement test. The assessment items of the tests were shown to both the classroom teacher and a testing and assessment expert to find out about the reliability and validity of the items.

The medium of grades taken from standardized tests that evaluate a learner's understanding of a specific course level is 42 out of the desired performance of 100, which is 58 points less than the best performance and 23 points less than the minimum expected performance. Her tests demonstrate that she can fulfill the requirements of the levels, but she has not mastered them yet. All that remains is for her to learn how to master it. Mastering a subject is the second step of Bloom's taxonomy of learning, which includes the cognitive domain. The cognitive domain involves knowledge and the development of intellectual skills (Bloom, 1956). This includes the recall or recognition and the ability to use specific facts by distinguishing, defining, explaining the meaning, and giving an example of target vocabulary. Accordingly, learner's achievement results, which were acquired in the first stage of this study, are presented in Table 1, and in Tables 2, 3, 4, 5, and 6, the data acquired from learner's, pre-post and retention tests in this study are summarized, in the findings section of this study.

2.7 Ethics

The study ensured the anonymity of the participant. The participant voluntarily participated in this study. Also, the study and its findings posed no harm to the participant.

3. Results

This study explored a question related to very long-term memory in the field of memory research: "Is it possible to acquire a certain number of vocabulary items for three consecutive weeks on different themes with mild dyslexia and retain them over the sixteen weeks after the intervention with game-based learning?" The findings related to the research question are as follows:

The learner's post-instruction achievement test grade on 'Vocabulary for Design" was 88, which had increased 22 points higher than the minimum expected performance. There was a significant difference between the pre-instruction achievement test and the post-instruction test, which indicated a considerable gain (table 1).

Table 1

Learner's Achievement Test Results in Preparatory School

	Learner's Test Results
Pre-Achievement Test in Preparatory School (General Score)	42 (out of 100)
Post-Achievement Test in Preparatory School (General Score)	88 (out of 100)

A low score on the pre-instruction (42) and a relatively high score on the post (88) indicated an improvement in the learner's vocabulary acquisition level. The learner performed significantly better

after the completion of the instruction. The learner was presented with the same learning material for 'vocabulary for design' after sixteen weeks without practice or a prior practice test. The aim was to measure a relatively permanent change in performance. The learner scored 65 on the retention test, which was 23 points less than sixteen weeks ago when she acquired new vocabulary and scored 88 on the achievement test (table 2).

Table 2

Learner's Retention Test Results – Design Vocabulary

	Learner's Test Results
Pre-Achievement Test in Preparatory School (General Score)	42 (out of 100)
Post-Achievement Test in Preparatory School (General Score)	88 (out of 100)
Pre-test on Design Vocabulary	65 (out of 100)
Post-test on Design Vocabulary	75 (out of 100)
Pre-test on Personality Vocabulary	10 (out of 100)
Post-test on Personality Vocabulary	95 (out of 100)
Pre-test on Travel Vocabulary	35 (out of 100)
Post-test on Travel Vocabulary	85 (out of 100)
Pre-test on Language Vocabulary	45 (out of 100)
Post-test on Language Vocabulary	90 (out of 100)

	Learner's Test Results	Learning Loss
Learner's Score (Sixteen Weeks later): Design Vocabulary	65	%35
Learner's Retention Rate	%74	%26

In this connection, the learner had lost 26% of what she had acquired four months ago, which corresponds to roughly one-quarter of what she had learned. Since the dyslexic learner could not remember %26 of what she had acquired (88) and she had missed 22 points, which indicates that learning did not occur in the first place; the retention rate is %74. The Ebbinghaus (2013) forgetting curve explains the human struggle with acquired information and how information stored within the brain is lost over time if the individual does not attempt to retain it. Immediately after the retention test, the learner was presented with another instruction for practice on 'Vocabulary for Design" of 51 words for a week to see how the test scores would improve after a week of study of the same vocabulary of design. The learner was given a post-test after reviewing the learning material for a week.

Table 3

Learner's Test Results – Design Vocabulary

	Learner's Test Results	Learning Loss
Learner's Retention Test Score: Design Vocabulary	65	%35
Learner's Post-test Grade: Design Vocabulary	75	%25

This time, with a tendency toward increase, the learner scored 75, meaning 25% of the total learning material was still not learned. Presenting another instruction and a post-test on the same material for the second time confirmed the retention rate and learning loss, which is around 25% (table 3). The learner was introduced to vocabulary under the personality theme next week, without any intervals: The new vocabulary consisted of 48 words. Her pre-test score was 10 out of 100. A week later, her post-test score was 95.

Table 4

Learner's Pre and Post-Test Results – Personality Vocabulary

	Learner's Test Results	Learning Loss
Learner's Pre-test Score: Personality Vocabulary	10	__
Learner's Post-test Grade: Personality Vocabulary	95	%5

The learner was given a post-test after reviewing the learning material for a week. This time, the dyslexic language learner received a score of 95 (table 4). It is noteworthy that the learner demanded a break for an unspecified time during the study with the excuse of "not being ready to face anything related to learning English" in the first place, and later with a health condition after she scored 95 on the post-test of newly learned vocabulary on the theme of personality, which might indicate a fear of success. The fear may stem from the outcomes and consequences of receiving a high grade and setting high expectations for herself. After her requirement for two days of space, the learner was presented with vocabulary under the travel theme next week: The new vocabulary comprised 53 words. She scored 45 out of 100 on the pre-test (table 5).

Table 5

Learner's Pre and Post-Test Results – Travel Vocabulary

	Learner's Test Results	Learning Loss
Learner's Pre-test Score: Travel Vocabulary	45	__
Learner's Post-test Score: Travel Vocabulary	90	%10

The learner was given a post-test again after revising the learning material for a week. This time the learner scored 90, missing just 10% of the learning material. The learner was presented with the last vocabulary theme on language, which consisted of 50 words. Her pre-test score was 35 out of 100.

Table 6

Learner's Pre and Post-Test Results – Language Vocabulary

	Learner's Test Results	Learning Loss
Learner's Pre-test Score: Vocabulary on the Theme of Language Vocabulary	35	__
Learner's Post-test Score: Language Vocabulary	85	%15

She scored 85 a week later, on the post-test. In her last test, she missed 15% of the learning material (table 6).

In this connection, it is possible to point out that the hypothesis of the study was in line with the work that was conducted well over a century ago by Ebbinghaus (1885–1962, reviewed in Anderson, 2000), who determined that forgetting (retention curve) is initially rapid but then continues at a decreasing rate (negative acceleration).

4. Conclusion

By using game-based learning to address her difficulty in acquiring a pre-defined number of vocabulary items in a given time, it was possible to support an adult dyslexic learner's vocabulary increase and retention. The learner was able to retain 74% of her acquired vocabulary (55 words a week) and learn 51% of her total vocabulary despite having mild dyslexia**.**

The findings reveal that game-based learning greatly developed dyslexic language learners' lexical resources. The findings showed a long-term effect on the acquisition of vocabulary based on Mayer's multimedia principle and game-based learning. A dyslexic learner's vocabulary increases, and

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retention is considered to open a way towards catching up to her peers and benefiting from inclusive education.

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