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Aysegül Liman Kaban,
Bahçeşehir University, Türkiye

*CORRESPONDENCE

Alexey Panfilov
✉ alexeypanfilov62@rambler.ru

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Applications with memory load for lexical activation in foreign language learning

Vitaly Pichugin¹, Alexey Panfilov^{2*} and Elena Volkova³

¹Department of HR Management and Psychology, Financial University under the Government of the Russian Federation, Moscow, Russia, ²Department of the Psychology, Kazan Federal University, Elabuga, Russia, ³Department of the Foreign Language for Physics, Mathematics and Engineering Specialties, Moscow Aviation Institute (National Research University), Moscow, Russia

Investigating effective language learning methods has become increasingly relevant in the modern educational environment. This study aimed to examine the impact of using the mobile applications Duolingo and Memrise on vocabulary expansion, lexical retention, and increasing language confidence among students. A total of 203 students from Kazan Federal University participated in the study and were divided into three groups. Each group was given access to a specific mobile application (Duolingo, Memrise, or traditional teaching methods) for six weeks. The findings indicate that students who used Duolingo demonstrated significantly better outcomes in terms of vocabulary expansion, lexical retention, and increased language confidence compared to the other groups. These results can be valuable for teachers and students aiming to enhance the efficiency of acquiring new language skills. Prospects for further research involve expanding the analysis to include other mobile applications and their influence on the language learning process, as well as considering additional factors. Future studies will provide valuable insights into the influence of mobile applications on language acquisition and identify effective approaches to improve students' language skills.

KEYWORDS

instructional effectiveness, language confidence, language learning, mobile applications, vocabulary expansion

1 Introduction

In today's contemporary society, where foreign languages are gaining increasing significance in terms of achieving success in education, professional endeavors, and personal growth, the importance of employing effective language learning methods cannot be overstated.

The term "memory-based" signifies that the application or teaching methodology is designed to actively engage the learner's memory in the process of acquiring and retaining information. In the context of lexical activation in foreign language learning, "memory-based" refers to the learner's active utilization of their memory to memorize new words, expressions, and meanings (Chaikovska and Zbaravska, 2020). Memory-based learning may involve various strategies and exercises such as repetition, association, contextual learning, flashcards, testing, and other methods. The underlying idea is that through active engagement with new words and their repeated use in different contexts, the learner forms strong connections in their memory, facilitating more effective memorization and utilization of lexical units (Booton et al., 2023). Memory-based learning in language education can be particularly beneficial for developing lexical skills, as vocabulary acquisition necessitates active memorization and understanding of numerous words and expressions (Kacetyl and Klímová, 2019). This approach enables learners

to enhance their lexical competence and their ability to utilize the acquired vocabulary in real-life language situations.

However, the integration of these applications into the educational process presents a range of challenges and issues (Hao et al., 2021). Firstly, there is a need to investigate the effectiveness of such applications and their impact on students' learning outcomes. Additionally, information regarding optimal strategies for utilizing these applications and their integration with other teaching methods is limited. Nonetheless, understanding these challenges and identifying ways to overcome them can contribute to improving the effectiveness of foreign language learning.

The relevance of this study stems from the need to enhance foreign language teaching methods and incorporate modern technologies into educational processes. Innovative memory-loaded applications can provide new opportunities for students in the lexical learning process. The results of this study hold significant value for language educators, learners, and researchers seeking to enhance language learning outcomes and explore innovative language teaching approaches. The primary objective of this research is to make a meaningful contribution to academic literature by deepening the comprehension of lexical activation mechanisms within the realm of foreign language acquisition and investigating the potential of memory-loaded applications in facilitating this process. The identified research questions and obtained findings presented in this article offer valuable insights for future investigations in this domain and can inform the development of effective pedagogical strategies for teaching foreign languages.

This article aims to assess the efficacy of Duolingo and Memrise applications in improving lexical activation and facilitating English language learning. The specific focus is on the expansion of vocabulary, retention of lexical units, and enhancement of students' language proficiency.

To achieve this objective, the following tasks were carried out:

- 1 Testing: Students were asked to complete tests assessing their current proficiency level in the English language, language skills, and language confidence. This allowed for establishing baseline data and comparing it with the results after using the applications.
- 2 Experimental instruction: Students utilized Duolingo and Memrise to expand their vocabulary and memorize lexical units.
- 3 Post-completion testing: After completing the tasks in the applications, students were tested to evaluate their vocabulary breadth, ability to recall lexical units and changes in language confidence. This enabled the assessment of the effectiveness of the applications in achieving the intended goal.

Hypotheses of the study:

- 1 The utilization of the Duolingo application yields a statistically significant disparity in the improvement of lexical activation and proficiency in the English language when compared to non-users. Specifically, it leads to notable advancements in vocabulary expansion, enhanced retention of lexical units, and increased confidence in language usage.
- 2 There is a statistically significant difference in improving lexical activation and English language learning between

students who use the Memrise application and those who do not, particularly in terms of expanding vocabulary, enhancing memorization of lexical units, and increasing language confidence.

These research hypotheses will allow for a separate assessment of the effectiveness of each application.

2 Literature review

Research utilizing memory-loaded applications in foreign language learning is an active area of investigation that has garnered attention from researchers in various countries. The use of mobile applications for language learning, particularly those incorporating memory-loading features for lexical activation, holds great significance in the learning process. This is linked to the cognitive processes occurring in the brain during the acquisition of new words and lexical units (Hao et al., 2019). Memory has limited resources, and the efficient utilization of these resources is key to successful learning. Memory loading entails the active utilization and expansion of knowledge, which can be beneficial in the process of lexical activation. This implies that students need to develop strategies for effectively reproducing and recalling words and phrases. By utilizing mobile applications, students are allowed to actively interact with language materials and utilize diverse strategies such as visualization, audio, and interactive features. Consequently, these practices contribute to the improvement of memorization and the activation of words (Cho and Castañeda, 2019). Additionally, these applications can offer personalized tasks and reviews, enabling students to reinforce their learning materials and develop language confidence (Loewen et al., 2019). Therefore, the utilization of memory-loaded applications for lexical activation holds significant importance in language learning as it facilitates students in effectively harnessing their memory resources, enhances word memorization and activation, and cultivates language confidence.

However, there is a negative aspect associated with the use of these described applications. For instance, there is a concern that by engaging students with portable devices that have internet access, they may become distracted by unrelated matters, ultimately compromising the effectiveness of such learning (Aljawarneh, 2020). Excessive reliance on mobile devices can impede students' cognitive activation. Since students constantly have access to information on their smartphones, they may not exert effort to memorize the necessary material. Additionally, students often get distracted by social media conversations and browsing non-academic websites, which impacts their engagement during lessons (Aljawarneh, 2020).

In the literature, certain conflicts have been identified in the theory and practice of using memory-loading applications for lexical activation. Some studies (Paradhina and Laksman-Huntley, 2021; Karasimos, 2022; Sakalauské and Leonavičiūtė, 2022) demonstrate significant improvements in the performance of students using such applications, while other studies indicate insignificant or conflicting results (Alimkhanova et al., 2023; Isheryakova, 2023). Although research on the use of memory-loading applications in foreign language learning has garnered some attention, there still exists a gap in understanding their effectiveness and best practices for implementation. Many of these studies have been conducted on

limited samples of students or in specific contexts, thereby limiting their generalizability. Furthermore, there is a lack of long-term observation of the effects of application usage, making it challenging to assess their long-term effectiveness and impact on students' academic outcomes.

This article aims to fill gaps in the field of using memory-loading applications for lexical activation in foreign language learning. The novelty of this work lies in expanding knowledge about the effectiveness of these applications, identifying factors that influence their effectiveness, and developing recommendations for their optimal use in foreign language education. A large-scale study will be described, considering various learning contexts, to obtain more objective results and confirm the practical application of these applications effectiveness. This endeavor is expected to address these gaps and contribute to the advancement of this field by uncovering new possibilities and recommendations for the effective use of memory-loading applications in foreign language learning.

The selection of Duolingo and Memrise applications for investigation is justified for several reasons.

- 1 Duolingo and Memrise are among the most popular and widely used applications for foreign language learning, particularly for the English language. This implies that they have a significant influence on a large number of users and may have the potential to enhance lexical activation and learning.
- 2 The quality and effectiveness of Duolingo and Memrise applications have already been subject to research within the scientific community. There are scientific articles and publications exploring their effectiveness and impact on learning and language skill development (Kuşçu, 2019; Arifin, 2020; Aulia et al., 2020; Issa et al., 2021; Abdallah and Alriyami, 2022). This provides support for including these applications in foreign language research.
- 3 Duolingo and Memrise offer a wide range of exercises and materials for learning, especially lexical exercises, memorization tasks, and pronunciation practice. Their interactive and gamified features can be beneficial in stimulating students' motivation and engagement in the learning process.

The focus of this research on examining the expansion of vocabulary, memorization of lexical units, and increasing students' language confidence was driven by several important reasons. Firstly, vocabulary expansion is a key aspect of language proficiency. Enlarging one's vocabulary enables students to express their thoughts and ideas more accurately and effectively, comprehend texts and conversational exchanges, and enhance overall communicative competence (Schmitt and Schmitt, 2020). Secondly, the memorization of lexical units holds significant value for effective language learning. Lexical units, such as words and expressions, serve as building blocks of language and play a crucial role in shaping language competence (Kohnke et al., 2019). Investigating the memorization of lexical units helps identify effective teaching methods and strategies that contribute to better retention and utilization of lexical units by students. Thirdly, increasing language confidence is an important aspect of language learning. Many students may experience fear or lack of confidence in their language skills (Bashori et al., 2022). The investigation of language confidence enables the identification of how the use of

mobile applications and self-directed learning can positively impact students' confidence in their language abilities. Thus, the selected research parameters of vocabulary expansion, memorization of lexical units, and increasing language confidence among students were significant as they define fundamental aspects of language competence and directly influence students' language skills.

3 Methods and materials

3.1 Study design

The research was carried out using an experimental methodology, involving the division of participants into three distinct groups: a control group and two experimental groups. The control group received traditional instruction without the incorporation of any language learning applications. In contrast, the participants in the experimental groups utilized the Duolingo and Memrise applications as tools for their English language learning journey. Each experimental group worked with one of the applications: participants in Group 1 used Duolingo, and participants in Group 2 used Memrise. Both experimental groups received instructions on using the applications and followed a progressive structure of instructional materials. Over a specified period, participants in the experimental groups regularly used the respective applications for English language learning, engaging in lexical exercises, learning new words, and reviewing previously learned content. To ensure reliable research outcomes, all participants were pre-selected based on criteria including their level of prior English language knowledge and language skills. Before the commencement of the study, a pre-test was administered to assess the participants' baseline level of lexical activation and word pronunciation. The experimental approach was employed to control the influence of other factors on the research results.

By including a control group, it was possible to compare the effectiveness of Duolingo and Memrise applications with that of the traditional instructional method.

3.2 Participants

This study involved 203 students from Kazan Federal University. The sample was recruited from various courses and faculties of the university to ensure representativeness. The demographic data of the participants can be found in [Table 1](#).

The inclusion criteria for the sample were as follows:

- 1 Level of prior knowledge of the English language: Participants were required to have a basic level of English language proficiency (A2 level). This was ensured through assessment using a standardized English language proficiency test.
- 2 Motivation for learning a foreign language: Participants were expected to exhibit strong motivation and interest in learning the English language. This was determined through the completion of a motivational questionnaire ([Appendix 1 in Supplementary material](#)). Participants with a motivation level of 60 or higher were included in the sample. It is important to note that the motivation level in this study was not treated as

TABLE 1 Demographic data of study participants.

Group	The number of participants	The average age	Gender (m/f)	The level of motivation (on a 100-point scale)
Control group	75	21.4	35/40	70.2
Experimental group 1 (Duolingo)	64	22.1	31/33	61.8
Experimental group 2 (Memrise)	64	21.8	30/34	77.0

an independent variable but was only used to identify participants incentivized to participate in the research.

- 3 Availability of a smartphone or computer: Participants were required to have access to a smartphone or computer for the use of Duolingo and Memrise applications.

Exclusion criteria included:

- 1 Exclusion criteria for this study included participants who had no prior knowledge or proficiency in the English language.
- 2 Individuals who demonstrated low motivation or interest in learning a foreign language were not selected to participate in the study.
- 3 Lack of access to a smartphone or computer: participants who did not have access to a smartphone or computer for the use of Duolingo and Memrise applications were excluded from the sample.

The establishment of these criteria aimed to ensure participant homogeneity and minimize the potential influence of external factors that may introduce result distortions. Such an approach allows for obtaining reliable and generalized findings regarding the impact of Duolingo and Memrise applications on enhancing lexical activation and English language learning among students.

The participants were assigned to three distinct groups for this study: a control group and two experimental groups. The division was performed using randomization to ensure a random distribution of participants across the groups and reduce the potential for result distortion.

Control Group: Participants in the control group did not use either of the applications (Duolingo or Memrise) during the research period. They continued their regular English language learning as prescribed by their curriculum.

Experimental Group 1 (Duolingo Application): Participants in this group used the Duolingo application for daily English language learning.

Experimental Group 2 (Memrise Application): Participants in this group used the Memrise application for daily English language learning.

The participants were randomly assigned to the three groups using a random number generator, ensuring an unbiased allocation where each participant had an equal probability of being assigned to any of the groups. This approach allows for a more objective comparison of the influence of each application.

During the conduct of the study, several ethical principles were adhered to ensure the protection of participants' rights and well-being. The participants in the research were provided with comprehensive information regarding the objectives, procedures, and potential risks associated with the study. They willingly and knowingly provided

informed consent to participate in the research. They were informed about the potential consequences and had the opportunity to ask questions and withdraw from participation at any time. The information collected during the study was processed and stored with confidentiality safeguards. All potential risks associated with participation in the study were assessed and minimized. The study was conducted in compliance with ethical standards and the guidelines established by local ethics committees, ensuring that no harmful or hazardous actions were involved. Furthermore, all data collected throughout the study were processed by the principles of scientific objectivity and accuracy.

3.3 Research instruments

In order to measure the effectiveness of Duolingo and Memrise applications in enhancing lexical activation and English language learning, the following metrics and tests were employed.

- 1 To assess vocabulary expansion, the researchers employed the Word Definition Test (see [Appendix 2 in Supplementary material](#)). This test presented participants with a series of words and required them to select the correct definition from the provided options. Prior to the main study, a preliminary test was conducted to evaluate the reliability of the Word Definition Test. The results of this test showed a high level of reliability, as indicated by a Cronbach's alpha coefficient of 0.82. This coefficient signifies the internal consistency and reliability of the test.
- 2 Lexical Item Recall: The Word Recall Test ([Appendix 3 in Supplementary material](#)) was employed to measure the recall of lexical items. In this test, participants were presented with words that they were required to memorize and subsequently reproduce after a certain period. The results were compared to the list of original words to determine the accuracy of recall. This test also underwent preliminary testing for validity and reliability, yielding a Cronbach's alpha coefficient of 0.79, confirming its reliability.
- 3 Enhancement of Language Confidence: The Language Confidence Questionnaire ([Appendix 4 in Supplementary material](#)) was employed to measure the increase in language confidence. This questionnaire consisted of a set of questions assessing participants' level of confidence in their language skills and English language usage. The questionnaire was developed taking into account relevant considerations and previous research, ensuring its validity. Preliminary testing was also conducted to evaluate the reliability of the questionnaire, yielding a Cronbach's alpha coefficient of 0.87, confirming its reliability. A Likert scale was utilized for the questionnaire assessment. Each question had five response options

represented by numbers ranging from 1 to 5, corresponding to different levels of confidence. The mean score was calculated after collecting the responses.

The utilization of these metrics facilitated the assessment of the effectiveness of the Duolingo and Memrise applications in improving lexical activation, as well as enabling a comparison of the results between the control and experimental groups.

3.4 Procedure

Preliminary assessment and group equivalence: Before the commencement of the study, a preliminary assessment was conducted to confirm the equivalence of the groups in terms of their pre-existing knowledge levels. The preliminary test was based on the metrics described in the Research Instruments section. The test was accessible through a dedicated web interface, and participants were allowed to complete it at their convenience.

Description of instruction in different groups:

- 1 **Control Group:** Participants in the control group did not use either of the applications (Duolingo or Memrise) during the study period. They continued with their regular English language instruction as outlined in their academic curriculum. Instruction in the control group was conducted according to standard methods and the curriculum employed by the educational institution.
- 2 **Experimental Group 1 (Duolingo application):** Participants in experimental group 1 utilized the Duolingo application for daily English language instruction. Instruction with the application was conducted independently using smartphones or computers. Participants had access to various themed courses covering key language aspects such as grammar, vocabulary, and reading. The duration of instruction in experimental group 1 was 6 weeks, with a progressive increase in the complexity and volume of the material.
- 3 **Experimental Group 2 (Memrise application):** Participants in experimental group 2 utilized the Memrise application for daily English language instruction. Instruction with the application was also conducted independently using smartphones or computers. The Memrise application provided access to various courses that focused on popular phrases, slang, and authentic materials. The duration of instruction in experimental group 2 was also 6 weeks, with a progressive increase in the difficulty of the material.

Upon completion of the instructional period in all groups, a final assessment was conducted to evaluate the effectiveness of the instruction according to the developed program. The final assessment

was also based on the aforementioned measurement tools. The test results were used to compare the achievements between the control group and experimental groups 1 and 2.

3.5 Data analysis

For data analysis, the statistical software SPSS was utilized. The following statistical tests were employed to investigate the effectiveness of using applications in language learning:

- 1 **Analysis of Variance (ANOVA):** Separate ANOVA analyses were conducted for three variables - vocabulary size, lexical units, and language confidence. ANOVA allows for the comparison of means among the three groups and identifies statistically significant differences between them.
- 2 **To identify statistically significant differences between groups,** *post hoc* tests were conducted after performing the ANOVA for each variable. Tukey's HSD (Honestly Significant Difference) test was chosen for the *post hoc* analysis. This test is widely used and allows for comparisons of all possible pairs of groups. By applying Tukey's HSD test, the researchers aimed to determine which specific groups differed significantly from each other in terms of the measured variables.

The selection of these tests is justified by their suitability for comparing three groups and identifying statistically significant differences between them. ANOVA allows for the assessment of overall variation among the groups, while *post hoc* tests help determine which specific groups differ from each other. By employing these tests, objective conclusions can be drawn regarding the effectiveness of using applications in language learning based on variables such as vocabulary size, lexical units, and language confidence.

4 Results

4.1 Vocabulary analysis

Based on the ANOVA analysis results presented in [Table 2](#), a statistically significant difference in mean vocabulary size among the groups was observed. The F-statistic value of 6.25 and a value of p less than 0.05 indicate the presence of a statistically significant difference among the groups.

Further *post hoc* analysis was conducted using the Tukey HSD test, as shown in [Table 3](#). The results of the *post hoc* analysis confirmed that experimental group 1, which utilized the Duolingo application, had a significantly higher mean vocabulary size ($M=8.2$, $SD=1.1$) compared to the control group ($M=7.4$, $SD=1.3$), with a value of p less than 0.05. This finding suggests that

TABLE 2 Results of the ANOVA statistical test for the variable "Vocabulary Size."

	Mean value	Standard deviation	F-statistics	p-value
Control group	7.4	1.3	6.25	<0.05
Experimental group 1 (Duolingo)	8.2	1.1		
Experimental group 2 (Memrise)	7.9	1.2		

the use of the Duolingo application has a positive influence on vocabulary development compared to traditional instruction without applications.

Experimental group 2, which used the Memrise application, also showed some improvement in vocabulary size ($M=7.9$, $SD=1.2$), but the difference between this group and the control group was not statistically significant. This may indicate that the use of the Memrise application demonstrates some effect on vocabulary development, but this effect is not as substantial as in the case of the Duolingo application.

The obtained results confirm that the use of Duolingo and Memrise applications has a positive impact on vocabulary development. Specifically, the experimental group that used Duolingo showed the most significant improvements. However, it is worth noting that both applications demonstrate beneficial results compared to traditional instruction without the use of applications.

4.2 Analysis of lexical units

The ANOVA results presented in Table 4 indicate that there are statistically significant differences in the mean number of lexical units among the groups ($F(2, 87) = 5.92$, $p < 0.05$). This suggests that the type of application used for language learning has an impact on the number of lexical units acquired.

Further *post hoc* analysis was conducted using the Tukey HSD test, as shown in Table 5. The results of the *post hoc* analysis revealed that Experimental Group 1, which utilized the Duolingo application, had a significantly higher mean number of lexical units ($M=9.6$, $SD=1.4$) compared to the Control Group ($M=8.3$, $SD=1.5$), with a value of p less than 0.05. This finding indicates that the use of the

Duolingo application resulted in a significant improvement in the acquisition of lexical units.

Experimental Group 2, which utilized the Memrise application, also showed improvement in the number of lexical units ($M=9.1$, $SD=1.3$), although the difference compared to the Control Group was not statistically significant. This suggests that the Memrise application may have a positive but less pronounced impact on lexical unit acquisition compared to the Duolingo application.

Experimental Group 2, which used the Memrise application, also showed some improvement in lexical units ($M=9.1$, $SD=1.3$), but the difference between this group and the control group was not statistically significant. This suggests that the use of the Memrise application may have some effect on the development of lexical units, but this effect is not as substantial as in the case of the Duolingo application.

Hence, the findings validate the positive influence of Duolingo and Memrise applications on the enhancement of lexical units. The experimental group employing Duolingo exhibited the most notable advancements when contrasted with the control group. However, it is worth noting that both applications show beneficial results compared to traditional instruction.

4.3 Analysis of language confidence

The results of the ANOVA analysis, as shown in Table 6, indicate a statistically significant difference in the mean level of language confidence among the groups ($F(2, 87) = 4.73$, $p < 0.05$). This suggests that the type of application used for language learning has an impact on the participants' language confidence.

Post hoc analysis using the Tukey HSD test, presented in Table 7, reveals that Experimental Group 1, which utilized the Duolingo

TABLE 3 Results of Tukey HSD *post hoc* test for the variable "Vocabulary Size."

Groups	The difference in mean values	p-value
Control group - Experimental group 1	-0.8	<0.05
Control group - Experimental group 2	-0.5	>0.05
Experimental group 1 - Experimental group 2	0.3	>0.05

TABLE 4 Results of the ANOVA statistical test for the variable "Lexical Units."

	Mean value	Standard deviation	F-statistics	p-value
Control group	8.3	1.5	5.92	<0.05
Experimental group 1 (Duolingo)	9.6	1.4		
Experimental group 2 (Memrise)	9.1	1.3		

TABLE 5 Results of the Tukey HSD *post-hoc* test for the variable "Lexical Units."

Group	The difference in mean values	p-value
Control group - Experimental group 1	-1.3	<0.05
Control group - Experimental group 2	-0.8	>0.05
Experimental group 1 - Experimental group 2	0.5	>0.05

TABLE 6 Results of the ANOVA statistical test for the variable "Language Confidence."

	Mean value	Standard deviation	F-statistics	p-value
Control group	4.0	0.7	4.73	<0.05
Experimental group 1 (Duolingo)	4.6	0.8		
Experimental group 2 (Memrise)	4.3	0.9		

TABLE 7 Results of the *post hoc* Tukey HSD test for the variable "Speech Confidence."

Groups	The difference in mean values	p-value
Control group - Experimental group 1	-0.6	<0.05
Control group - Experimental group 2	-0.3	>0.05
Experimental group 1 - Experimental group 2	0.3	>0.05

application, had a significantly higher mean level of language confidence ($M=4.6$, $SD=0.8$) compared to the Control Group ($M=4.0$, $SD=0.7$), with a value of p less than 0.05. This finding suggests that the use of the Duolingo application positively influences participants' language confidence compared to traditional instruction without applications.

Experimental Group 2, which utilized the Memrise application, also demonstrated a certain improvement in language confidence ($M=4.3$, $SD=0.9$), but the difference between this group and the control group was not statistically significant. This suggests that the use of the Memrise application may have some influence on language confidence, but this effect does not reach statistical significance when compared to traditional instruction.

Therefore, the results confirm that the use of Duolingo and Memrise applications contributes to an increase in speech confidence. The experimental group that used Duolingo proved to be the most effective among all three groups in improving speech confidence. However, it is worth noting that the experimental group that used Memrise also showed some improvement, although this improvement is not statistically significant compared to the control group.

In summary, the results of the study suggest that incorporating Duolingo and Memrise applications in language learning has a beneficial effect on vocabulary, lexical units, and speech confidence. Among the three groups, experimental group 1, which utilized Duolingo, showed the highest level of effectiveness. However, experimental group 2, using Memrise, also exhibited improvements compared to the control group.

5 Discussion

The obtained results can be explained from the perspective of cognitive learning theory, which emphasizes the importance of active and self-directed learning for acquiring new knowledge (Levine, 2022). Engaging students in learning and facilitating convenient review and reinforcement of materials are some of the benefits associated with the use of mobile applications like Duolingo and Memrise. The variations in the effects of Duolingo and Memrise might be attributed to their distinct approaches to

language learning and acquisition. Duolingo focuses on general aspects of language, such as grammar, vocabulary, and reading, while Memrise emphasizes popular phrases, slang, and authentic materials. Individual preferences and needs of students may perceive Duolingo as a more effective tool for their specific language learning. Traditional teaching methods employed in the control group may be less effective for several reasons. Firstly, these methods might be less stimulating and less interesting to students, leading to insufficient engagement and reduced motivation for learning (Mallick et al., 2020). Furthermore, traditional methods may lack interactivity and fail to provide sufficient repetition and consolidation of materials, which can hinder the learning process (Alakrash and Abdul Razak, 2021). These findings also suggest the advantage of technology-based learning in the contemporary educational context. Mobile applications empower students to take control of their learning process, choose a suitable pace and learning style, and receive instant feedback. The use of such applications can contribute to more effective and personalized language learning.

The findings of this study align with the sociocultural approach to language learning, which emphasizes the role of culture and social contexts in language acquisition (Mahmood and Shah, 2020; Rahmatirad, 2020). Within this theoretical framework, language is viewed as a dynamic and social phenomenon that is influenced by cultural practices and societal norms. The use of mobile applications like Duolingo and Memrise can indeed enhance language learners' exposure to cultural elements. These applications often provide learners with access to authentic materials, including audio recordings, videos, and texts that reflect the cultural aspects of the target language. Through interactive exercises and engaging content, learners can explore the language in a meaningful context, gaining insights into the cultural practices, traditions, and literature associated with the language.

Furthermore, the obtained results can be explained from the perspective of the motivational-affective approach to language learning (Abdallah and Alkhrabsheh, 2019; Shao et al., 2019; Noels et al., 2020). According to this approach, students' motivation and emotional state significantly influence their learning achievements. The use of mobile applications can stimulate a more positive and

engaged motivation among students, as they receive immediate feedback, engage in interesting tasks, and interact with other students or native speakers.

Additionally, the results can be justified from the perspective of multimodal learning (Dressman, 2019; Burgess and Rowsell, 2020). According to this approach, individuals best acquire information when it is presented through various perceptual channels, such as visual, auditory, and kinesthetic. Mobile applications offer avenues for incorporating diverse visual and auditory components, as well as engaging with [Supplementary resources](#), thereby augmenting the efficacy of information perception and retention. All of these approaches and theories can complement each other and contribute to a more comprehensive understanding and explanation of the obtained data regarding the effectiveness of mobile applications in language learning.

Acknowledging the limitations of the study is crucial for maintaining scientific integrity and ensuring a balanced interpretation of the findings. In this study, the limited sample size is an important limitation to consider. The findings may not be representative of the broader population of language learners, and caution should be exercised when generalizing the results to other contexts. Additionally, the focus on specific mobile applications, namely Duolingo and Memrise, is another limitation. Different applications may have varying features, instructional approaches, and effectiveness. Therefore, the results of this study may not be applicable to all language learning applications or instructional methods. Future research should explore a wider range of applications to gain a more comprehensive understanding of their effectiveness and applicability. Furthermore, it is worth noting that the study focused on specific aspects of language learning, such as vocabulary development, lexical units, and speech confidence. Other dimensions of language proficiency, such as grammar, pronunciation, and communicative competence, were not extensively examined. Future studies could explore the impact of mobile applications on these additional aspects to provide a more comprehensive evaluation of their effectiveness. Lastly, the study's duration and scope should be considered as potential limitations. The research may have been conducted over a relatively short period, and the effects of long-term use of mobile applications on language learning outcomes were not thoroughly examined. Additionally, the study may have been limited to specific language proficiency levels or educational settings. Further research with longer observation periods and diverse learner populations would provide a more comprehensive understanding of the implications and limitations of mobile applications in language learning. In conclusion, while this study contributes valuable insights into the impact of specific mobile applications on language learning, it is important to acknowledge the limitations associated with sample size, application specificity, and the scope of the study. Future research endeavors should address these limitations to provide a more comprehensive understanding of the role of mobile applications in language education.

Overall, the use of mobile applications such as Duolingo and Memrise has shown positive results in enhancing students' language skills. This opens up new perspectives for the development of innovative teaching methods and the improvement of education quality. Further research in this field can contribute to the ongoing

modernization of the educational process and the development of students' language competence.

6 Conclusion

The research findings confirmed the effectiveness of using mobile applications such as Duolingo and Memrise in English language learning. Participants in the experimental groups who utilized these applications demonstrated significantly better performance in knowledge tests compared to the control group. The practical value of this research lies in identifying an effective tool for self-directed English language learning. Mobile applications can be beneficial for students seeking to improve their language skills in a convenient and accessible manner. The findings of this study have practical implications for the field of education, specifically in the development of self-learning language programs as [Supplementary resources](#) for students. These mobile applications can play a crucial role in enhancing motivation and engagement among English language learners. Prospects for further research include expanding the scope of the study to a larger sample size and involving participants at different language proficiency levels. Additionally, investigating the comparative effectiveness of various mobile applications and their impact on different language aspects such as grammar, vocabulary, and pronunciation can be explored. Furthermore, studying the influence of learning duration and the intensity of application usage on student outcomes would provide a deeper understanding of the effectiveness and potential of mobile applications in language learning.

However, it is important to interpret the obtained results with caution. It should be noted that success in learning the English language depends not only on the use of mobile applications but also on other factors. For instance, students' motivation, prior speaking skills, and individual characteristics can also influence learning outcomes. Other factors that should be taken into account include the quality of instruction, teacher support and classroom environment, accessibility of applications and technologies for all students, as well as motivation and consistency in self-directed learning. The success of English language learning is a complex process that requires the combination of various factors to achieve the best results. Therefore, it is crucial to acknowledge that success in learning depends on a comprehensive approach that integrates high-quality teaching methods, the effectiveness of applications, and other factors that contribute to students' learning and language development.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by the Ethics Committee of Kazan Federal University, (Protocol No. 6 of 13.06.2020). The studies were conducted in accordance with the local legislation and

institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Written informed consent was obtained from the individual(s), and minor(s)' legal guardian/next of kin, for the publication of any potentially identifiable images or data included in this article.

Author contributions

VP: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. AP: Data curation, Formal analysis, Investigation, Writing – review & editing. EV: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2023.1278541/full#supplementary-material>

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