



Review article

## A Content Analysis of the Duolingo Application

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### Abstract

In recent years, the increasing role of digital Technologies in foreign language learning and teaching has led to a more widespread use of digital applications in education. In this context, the Duolingo application, with its user-friendly interface, gamified activities, wide range of languages, and coverage of fundamental language skills such as reading, writing, listening and speaking, has become a focal point of interest for both individual users and researchers. The primary aim of this study is to examine articles on the Duolingo application published between 2020 and 2025 through content analysis, in order to identify gaps and recurring themes in the literature. The research was conducted using a qualitative design, employing content analysis as the data collection and analysis method. National and international academic articles were systematically evaluated and analyzed based on categories such as publication year, country, research methodology, themes, participant groups, and target languages. A total of 81 articles were included and analyzed within the scope of this study. Findings indicate that studies on the Duolingo application display geographical diversity and are shaped by contributions from researchers across various countries. In terms of research methodologies, the studies approach the subject from multiple perspectives. Thematically, mobile-assisted language learning (MALL), vocabulary acquisition, gamification, and fundamental language skills are emphasized. This study provides a systemic overview of the academic status and development of the Duolingo application over time, offering a resource to guide future research in the field.

**Keywords:** Duolingo, Foreign Language, Digital Technology, Content Analysis

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## INTRODUCTION

The rapid development of digital technologies has significantly transformed foreign language learning and teaching processes; especially out-of-class learning environments and technology-supported language learning have become important areas of study that attract the attention of researchers (Reinders & Benson 2017). Traditional teaching methods have been replaced by technology-supported applications. Particularly in foreign language teaching, digital applications provide accessibility, interaction, personalized learning processes, and the opportunity for language learners to progress in accordance with their proficiency levels (Burston, 2014). In this context, the Duolingo application, which stands out among these applications, attracts attention in both individual and academic domains with its user-friendly interface, gamification-based activities, and content aimed at developing the four fundamental language skills, reading, writing, listening, and speaking. Therefore, it is important to examine the studies conducted on the Duolingo application and to evaluate their findings.

The integration of digital learning environments into foreign language education is examined not only on the basis of the opportunities provided by technological innovations but also in terms of the interaction of these tools with pedagogical theories. In this context, Mayer's (2009) Multimedia Learning Theory reveals that the combined use of visual and auditory elements can support meaningful learning by reducing cognitive load. Duolingo's structure, which presents audio, visual, text, and interactive activities together, aligns with the fundamental principles of this theory. Furthermore, the TPACK (Technological Pedagogical Content Knowledge) model developed by Mishra and Koehler (2006) emphasizes the importance of using technology in integration with pedagogical and content knowledge. In this respect, by combining content for language teaching with technology-supported activities, Duolingo exemplifies the integrated structure proposed by the TPACK model. On the other hand, in the field of mobile language learning, Kukulska-Hulme (2018) and Sharples (2013) state that mobile Technologies provide learners with a time and location-independent, personalized learning experience. Duolingo's mobile structure, which allows users to progress at their own learning pace, also supports this approach. Multimedia Learning Theory, the TPACK model, and the mobile language learning approach can be evaluated as complementary theoretical perspectives; Duolingo, in terms of its use of multimedia elements, provision of technology integration for pedagogical purposes, and offering of mobile learning opportunities, stands at the intersection of these theoretical approaches.

In recent years, studies have demonstrated that Duolingo can be used not only in individual learning processes but also as a supplementary tool in formal educational settings (Munday, 2016). Duolingo's gamification-based structure, continuity, and learner autonomy have made it one of the frequently discussed examples in the literature on mobile-assisted language learning (MALL) (Godwin-Jones, 2018). Moreover, studies conducted in different countries indicate that the Duolingo is a widely used digital language learning tool on a global scale, and findings regarding the application's

effectiveness can vary depending on the learning context, participant characteristics, and educational settings (Shortt et al., 2021; Vesellinov & Grego, 2012). This situation reveals that the application is an important research subject not only in terms of its pedagogical potential but also for understanding the precesses of digitalization in language learning. Despite this, it is observed that reviews presenting the general trends, focused themes, and methodological characteristics of studies conducted on Duolingo from a holistic perspective are limited.

For this purpose, in this study, an examination of academic studies conducted on the ‘‘Duolingo’’ application, which is one of the Web 2.0 tools, was carried out, and a content analysis was conducted. In this context, it was revealed how foreign language teaching was addressed in relation to the ‘‘Duolingo’’ application, which methods and approaches were used in the stuides conducted, on which sample groups the studies were carried out, and which results were obtained. Another aim of the study is to identify the gaps and recurring themes in the existing literature, to provide direction for future academic studies on the ‘‘Duolingo’’ application, and to provide a qualified source.

In order to support this aim, the sub-objectives sought to be answered in the research ara as follows:

- To determine the distribution of article studies conducted on the Duolingo application by years.
- To determine the distribution of the studies conducted by countries.
- To determine the research methods used in the studies (qualitative, quantitative, mixed, etc.).
- To determine the thematic distribution of the studies.
- To examine the sample groups of the studies (students, teachers, pre-service teachers, academicians, etc.) and the sample sizes.
- To determine which language skills (reading, writing, listening, speaking, vocabulary skills, grammar) were addressed in the studies.

## **METHOD**

### **Research Model**

This research was designed based on the qualitative research method. Since the study aimed to reveal the methodological and thematic characteristics of academic studies related to the Duolingo application, to determine the general trends in the current literature, and to examine the distributions of the studies across different dimensions, the document analysis method was preferred. Document analysis is a data collection method that enables the systematic analysis of written materials containing information about the phenomenon or phenomena targeted for investigation (Yıldırım & Şimşek, 2021). Since the aim of the research is to present a general overview of the studies produced in this field rather

than evaluating the effectiveness of the Duolingo application, an approach based on document analysis was adopted instead of a systematic review and meta-analysis.

In the analysis of the obtained data, the content analysis method was used. The main purpose of content analysis is to bring together data that are similar to each other within the framework of specific concepts and themes and to interpret them by organizing them (Miles et al., 2014). In this direction, academic studies conducted on the Duolingo application were examined in terms of their publication years, research methods, sample groups, the language skills they addressed, and various research characteristics, thereby presenting a general overview of the literature.

### **Data Sources**

The data sources of this research consist of articles published in national and international academic journals regarding the ‘‘Duolingo’’ application between 2020 and 2025. A total of 81 articles accessible within the specified date range were included in the analysis.

### **Data Collection**

During the data collection process, the online databases such as Google Scholar, ERIC, DergiPark, and ResearchGate, along with international indexes widely used in the literature, were searched, and the articles to be examined within the scope of the research were identified from these sources. In the search process, keywords such as ‘‘Duolingo’’, ‘‘foreign language learning’’, ‘‘mobile-assisted language learning’’ and ‘‘digital language tools’’ were used, and the Turkish and German equivalents of these keywords were also taken into consideration. As a result of the comprehensive search conducted in the first stage, a large number of studies were reached, but these studies were evaluated in accordance with specific inclusion criteria. Studies meeting the criteria of being published between 2020 and 2025, being published in peer-reviewed journals, having full-text availability, and directly addressing the Duolingo application were included in the research.

In accordance with these criteria, studies that mentioned the word Duolingo but did not directly examine the application, fell outside the scope of the research, or whose full text could not be accessed were excluded from the analysis. As a result of the elimination process, a total of 81 studies that met all the criteria formed the dataset of research. The obtained studies were coded and analyzed in accordance with specific categories suitable for content analysis. Information regarding the distribution of the studies by years, countries, methods, main and sub-themes, sample groups, and target languages is presented in detail in the findings section.

### **Data Analysis**

The 81 articles examined in the study were systematically coded using the content analysis method. In this context, a coding form was developed by the researcher in accordance with the sub-objectives of the research and the related literature. The coding form consists of categories such as

publication year, country, where the research was conducted, research method, sample group, sample size, target language, language skills addressed, and research themes.

Each article was first examined in detail and then placed into the relevant categories in accordance with the determined coding form. During the coding process, the obtained data were grouped according to their similarities and differences and organized under themes, and frequency and distribution analyses were conducted on these themes. In line with the new data patterns that emerged during the process, the existing categories were reviewed, and thematic adjustments were made when necessary.

In content analysis, a systematic coding process is of great importance in order to classify, interpret, and compare the obtained data in a meaningful manner. Indeed, Büyüköztürk (2016) emphasizes that data analysis in the social sciences is not merely a technical procedure but also includes the researcher's responsibility to render the obtained data consistent, reliable, and comparable. In this context, the coding process was conducted based on clear and consistent criteria and was structured in a way that enhances the validity and reliability of the analysis process.

### **Validity and Reliability**

In qualitative research, validity is associated with the credibility of the study and the extent to which the findings reflect reality; reliability, on the other hand, is related to the consistency of the research process and the replicability of the findings (Karasar, 2012). In ensuring validity and reliability in this research, the criteria of credibility, transferability, dependability, and confirmability proposed by Lincoln and Guba (1985) were taken as a basis.

In this context, to increase credibility, the data collection and analysis processes have been explained in detail. To ensure transferability, the scope of the research, data sources, and analysis stages have been described in detail. To strengthen dependability, the coding process was carried out systematically, and all studies were examined in line with the same criteria. To ensure confirmability, the obtained data were evaluated directly in accordance with the research objective, and care was taken to ensure that interpretations were data-driven.

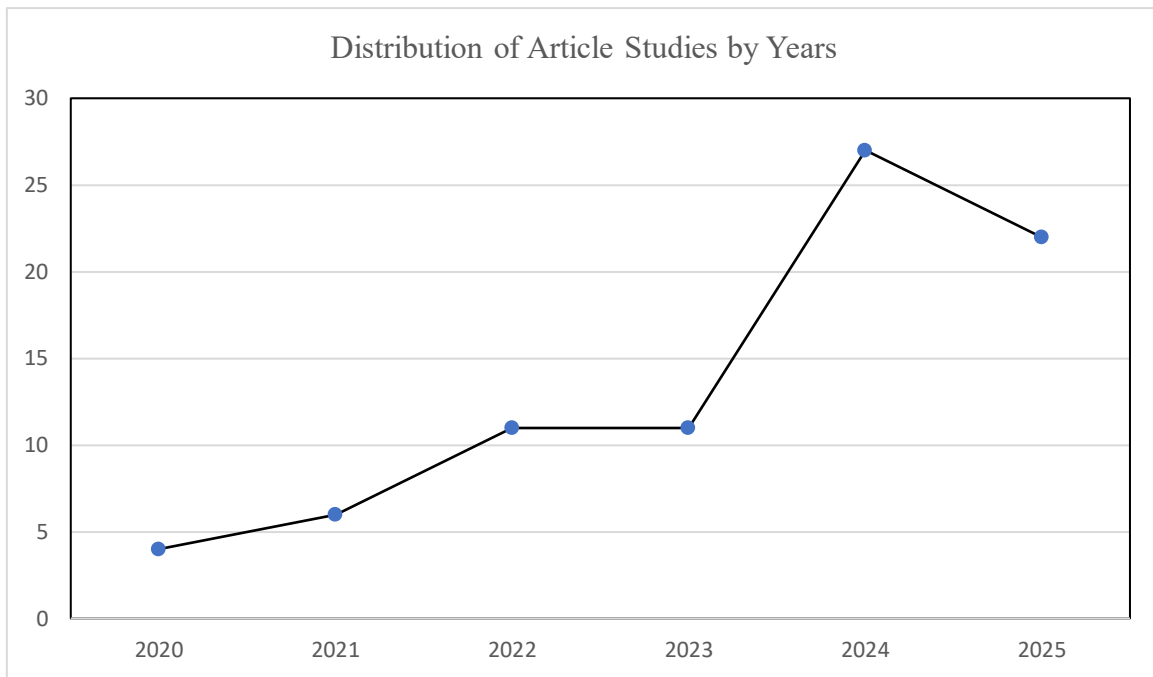
Furthermore, to ensure coding reliability in this study based on content analysis, a specific portion of the dataset was independently recorded by a field expert. The codings made by the researcher and the expert were compared, and disagreements were discussed to reach a consensus. Inter-coder agreement was calculated using the Miles and Huberman (1994) formula and determined to be 86.7%.

In this context, the research process was structured not only as a technical analysis process but also as a holistic and systematic evaluation process in accordance with the qualitative research approach.

## FINDINGS

In this section of the research, the data obtained through content analysis of the academic studies conducted on the “Duolingo” application are presented. The examined studies were classified according to various categories such as publication year, country distribution, research method, sample group, and data collection tools. The findings obtained were presented in tables or graphs, interpreted, and presented sequentially.

The distribution of the articles studies included in this research by years was examined in order to reveal the change in academic interest in the Duolingo application over time. In this context, articles published between 2020 and 2025 were evaluated, and the number of studies published each year was determined. The data regarding this distribution are presented in Figure 1 below in the form of a graph.



**Figure 1.** Distribution of Article Studies on the Duolingo Application by Years

When the article studies conducted on the Duolingo application between 2020 and 2025 are examined, an increasing trend by years is observed. In 2020, 4 (4.94%) studies were published, while in 2021, 6 (7.41%) studies were published. In 2022 and 2023, this number increased equally to 11, and both years constituted 13.58% of the total publications. In 2024, the highest number was reached with 27 studies. This corresponds to 33.3% of the total publications addressed in this study. Although the year 2025 has not yet been completed, with 22 studies reached, 27.16% of the total belongs to this year.

These data reveal that academic publications have shown an increase particularly since 2022 and that the Duolingo application has been addressed more intensively as a field of research. Furthermore, it is observed that these studies are not limited to a specific geography but have been shaped by the

contributions of researchers from various countries the world. This indicates that Duolingo is language learning application that attracts global interest and is the subject of research.

The findings regarding the distribution of the article studies by countries are presented in Table 1 below.

**Table 1.** Distribution of articles by countries

Countries	f	%
Indonesia / Malaysia	37	45.68
United States	12	14.81
Türkiye	6	7.41
Poland	5	6.17
France	3	3.70
Saudi Arabia	3	3.70
Italy	2	2.47
United Kingdom	2	2.47
China	2	2.47
Germany	1	1.23
Austria	1	1.23
Ukraine	1	1.23
Russia	1	1.23
Uzbekistan	1	1.23
North Macedonia	1	1.23
Morocco	1	1.23
Benin (West Africa)	1	1.23
Thailand	1	1.23
Total	81	100

The findings presented in Table 1 reveal that the article studies related to the Duolingo application show considerable diversity in terms of geographical distribution. The highest proportion of studies is concentrated in Southeast Asian countries such as Indonesia and Malaysia (f=37; 45.68%). This categorization is based on the joint coding of the relevant countries, as some studies were conducted collaboratively by universities or author institutions from multiple countries. The United States (f=12; 14.81%) draws attention with its contribution in this field. Türkiye (f=6; 7.41%) also holds a significant place among the article studies conducted on Duolingo. Among European countries, Poland (f=5; 6.17%), France (f=3; 3.70%), Italy (f=2; 2.47%), the United Kingdom (f=2; 2.47%), Germany (f=1; 1.23%), and Austria (f=1; 1.23%) stand out, while countries such as China (f=2; 2.47%), Ukraine (f=1; 1.23%), Russia (f=1; 1.23%), Uzbekistan (f=1; 1.23%), Thailand (f=1; 1.23%), and North Macedonia (f=1; 1.23%) also contribute to the field. From the African continent, countries such as Benin and Morocco (f=1; 1.23%) are also included in the study. This situation indicates that Duolingo attracts interest in different countries on a global scale.

In addition to geographical distributions, the diversity of the articles in terms of research methods constitutes another important dimension. This distribution is visually presented in table 2.

**Table 2.** Distribution of studies by research methods (Mixed, Qualitative, Quantitative)

<b>Methods</b>	<b>f</b>	<b>%</b>
Qualitative	36	45
Quantitative	27	33
Mixed	18	22
Total	81	100

Of the examined articles, 45% (f=36) were conducted using qualitative methods, 33% (f=27) using quantitative methods, and 22% (f=18) using mixed methods. These results indicate that qualitative research is particularly prominent in the field and the subject has been addressed in a multidimensional manner through different methods. This distribution is visually presented in Table 2.

In addition to the methodological characteristics of the studies, the themes they addressed were also examined and classified under specific categories. In order to systematically present the themes addressed in the studies, they are provided in Table 3.

**Table 3.** Thematic classification of articles conducted on Duolingo

Main Theme	Sub-Theme	f	%
Language Learning-Oriented Themes	Mobile-Assisted Language Learning (MALL)	15	18.75
	Vocabulary Learning	9	11.25
	Grammar	6	7.5
	Translation Skill	1	1.25
	Language Skills (All Skills)	10	12.5
	Speaking Skill	5	6.25
	Listening Skill	1	1.25
	Writing Skill	1	1.25
	Reading Skill	2	2.5
Technological Approaches and Digital Learning	Gamification	7	8.75
	Artificial Intelligence	3	3.75
	Technology-Supported Language Learning	3	3.75
	Educational Technology	3	3.75
	Language and Technology	2	2.5
	Web 2.0 Digital Competence	1	1.25
Learner-Oriented Themes	Student Motivation and Learning	4	5
	Perception and Attitude	2	2.5
	Student Attitudes and Perceptions	1	1.25
	User Perceptions and Experience	3	3.75
	User Feedback	2	2.5
	Usability	1	1.25
Assessment, Evaluation, and Other Academic Focuses	Test Validity and Proficiency	4	5
	Language Assessment	1	1.25
	Academic Interpretation of Test Scores	1	1.25
	Individual Language Learning	1	1.25
	Teacher Perceptions and Views	2	2.5
	Teaching Method and Technique Limitations	1	1.25
	Accent and Assessment	1	1.25

According to Table 3, the thematic distribution of the articles conducted on the Duolingo application is classified under four main themes. These themes are structured as Language Learning-Oriented Themes, Technological Approaches and Digital Learning, Learner-Oriented Themes, and Assessment, Evaluation, and Other Academic Focuses

Under the main heading of Language Learning-Oriented Themes, the sub-theme with highest representation rate is Mobile-Assisted Language Learning (MALL), which constitutes the highest frequency with 15 articles (18,75%). This is followed by the Language Skills (All Skills) sub-theme (f=10; 12.5%) and Vocabulary Learning (f=9; 11.25%). While Grammar (f=6; 7.5%) and Speaking Skill (f=5; 6.25%) are moderately represented, Reading Skill (f=2; 2.5%), Listening Skill (f=1; 1.25%), Writing Skill (f=1; 1.25%), and Translation Skill (f=1; 1.25%) are included with lower frequencies.

Within the scope of the Technological Approches and Digital Learning theme, Gamification (f=7; 8.75%) stands out as the most domination sub-theme. The sub-themes of Artificial Intelligence, Technology-Supported Language Learning, and Educational Technology are equally represented with 3 articles each (3.75%). Additionally, the sub-themes of Language and Technology (f=2; 2.5%) and Web 2.0 Digital Competence (f=1; 1,25%) are included in this category at a more limited level. Under the Learner-Oriented Themes heading, Student Motivation and Learning (f=4; 5%) draws attention as the sub-teheme with the highest frequency. User Perceptions and Experience (f=3; 3,75%), Perception and Attitude (f=2; 2.5%), and User Feedback (f=2; 2.5%) are represented at a moderate level, whereas Student Attitudes and Perceptions (f=1; 1.25%) and Usability (f=1; 1.25%) are at a lower level.

Within the Assessment, Evaluation, and Other Academic Focuses theme, Test Validity and Proficiency (f=4; 5%) is the most highly represented sub-theme, followed by Teacher Perceptions and Views (f=2; 2.5%). The sub-themes of Language Assessment, Academic Interpretation of Test Scores, Individual Language Learning, Teaching Method and Technique Limitations, and Accent and Assesment are each represented at a limited level with 1 article (1.25%).

Overall, the findings indicate that studies conducted on Duolingo are most densely concentrated in the context of language learning process and mobile-assisted learning, while technological approaches and learner-oriented variables also constitute an important research area.

Following these thematic analyses, the sample groups in the examined articles were adressed in Table 4, and the profiles of the participants were presented. Information regarding the target languages is presented in the esplanation below.

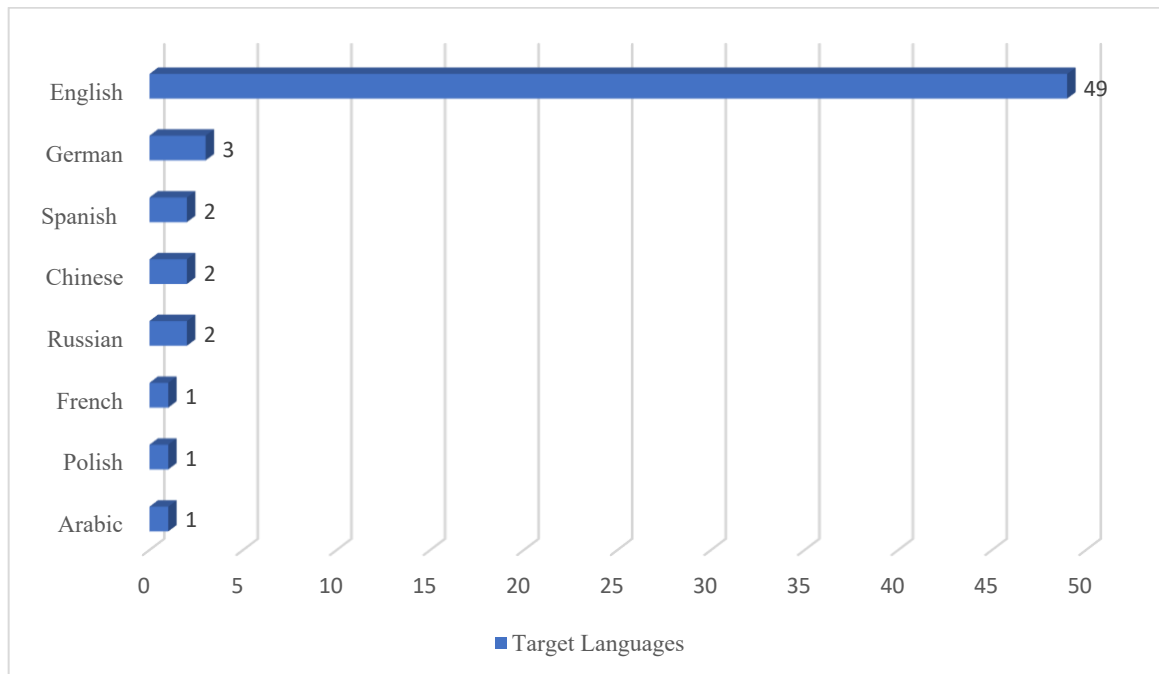
**Table 4.** Distribution of sample groups

<b>Participant Group</b>	<b>Sub-Group / Level</b>	<b>n</b>
Faculty Member		45
Administrative Staff		39
Teacher		271
User / Volunteer		355
Student	Primary/Middle/HighSchool	1129
	Undergraduate	1225
	Graduate	1442
Total		4506

In the examined article studies, the sample consists of a total of 4506 participants covers different educational and professional groups: 45 faculty members, 39 administrative staff, 271 teachers, 355 volunteers and Duolingo users, and 3796 students. When the students are divided into sub-groups, it was determined that 1129 were at primary, middle, and high school levels, 1225 were undergraduate, and 1442 were graduate students.

When the languages studied or learned by all participants were examined, English (n=49) was the most common target language, while German (n=3), Spanish (n=2), Chinese (n=2), Russian (n=2), French (n=1), Polish (n=1), and Arabic (n=1) were also included as target languages in the articles. The participant groups and target language information obtained from the 81 examined articles demonstrate the diversity of samples in Duolingo research. However, target language and sample information are not available in all articles; in some studies, such demographic data were not reported. These findings contribute to the academic value of the study by revealing the scope of the content analysis and identifying which user groups and target languages were addressed in the articles. Accordingly, the distribution of the target languages explicitly stated in the examined articles is presented below.

The distribution according to the target languages included in the examined articles is presented in Figure 2 below.



**Figure 2.** Distribution of target languages in the articles

When the distribution in Figure 2 is examined, it is observed that English (f=49; 80.33%) is the primary target language in the majority of the examined articles. Following English, German (f=3; 4.92%) ranks second. The representation levels of the other languages are relatively low. Spanish, Chinese, and Russian are each represented equally (f=2; 3.28%), while French, Polish, and Arabic each have the lowest representation rates (f=1; 1.64%). Among the 81 articles examined, it was determined that 61 studies explicitly stated the target language, while 20 studies did not provide information regarding the target language. Therefore, the analysis of target language distribution was conducted solely based on the studies that explicitly identified the target language. This distribution indicates that

the primary focus of the academic literature on the Duolingo application is concentrated on English language learning.

## **RESULTS and DISCUSSION**

This study presents a content analysis of 81 research articles conducted on the Duolingo application between 2020 and 2025. The findings reveal that academic interest in Duolingo, as one of the prominent digital language learning tools, has surged in recent years. In particular, the increase observed in the number of publications since 2023 indicates that digital language learning tools have become increasingly visible in academic research.

Research focusing on the impact of technology on language learning demonstrates that digital platforms contribute positively to students' motivation and learning experiences. This finding aligns with the growing role of mobile-assisted language learning (MALL) tools in educational processes, as highlighted by Godwin-Jones (2016) and Hulme and Morgana (2021). In this context, it can be stated that Duolingo is not merely an application but multidimensional digital learning tool that has become a subject of research in language learning processes. According to Kökçü (2023), Duolingo's accessible structure, which appeals to different languages and diverse user profiles, allows the application to be examined in various research areas. This demonstrates that Duolingo has become a versatile research topic addressed in various academic contexts.

Another noteworthy finding of the study is the geographical diversity of the research conducted on Duolingo. In particular, studies centered in Southeast Asian countries such as Indonesia and Malaysia frequently employ both quantitative and qualitative designs focusing on vocabulary learning and student perceptions. Moreover, one of the large-scale effectiveness studies on Duolingo was conducted with a sample based in the United States (Rahman et al., 2024). This distribution provides evidence that Duolingo has been examined in both developing and developed educational contexts, suggesting that the application has become a focal point of research across diverse geographical regions.

In addition, Duolingo's annual reports and published research outputs based on global user data (Duolingo Blog, 2024) offer further documentation regarding its wide accessibility and usage trends across different countries. In the Turkish context, perception and implementation-focused studies on Duolingo have begun to emerge in recent years, indicating growing interest among local researchers in digital language learning tools. Research on the role of technology in language learning demonstrates that digital platforms positively influence students' motivation and overall learning experiences. In particular, such applications eliminate time and space constraints, thereby providing learners with greater flexibility. The increasing adoption of these applications in Türkiye may be considered a significant step in the digitalization of foreign language education. Indeed, Aydın (2024), in a study conducted with Turkish EFL students, reported that mobile language learning applications such as

Duolingo and EWA English enhance learner motivation and contribute to the development of language skills.

With regard to the methodological distribution, the predominance of qualitative studies indicates that researchers primarily seek to gain an in-depth understanding of learners' experiences with Duolingo and to explore its pedagogical dimensions. However, the relatively limited number of quantitative studies suggests a need for further statistically grounded investigations into the application's impact on learning outcomes. Mixed-methods studies, by integrating both qualitative and quantitative approaches, offer the opportunity for a more holistic analysis.

Among the main themes addressed in the reviewed studies, Mobile-Assisted Language Learning (MALL), vocabulary acquisition, gamification, and core language skills emerge as prominent areas of focus. These findings are consistent with the broader literature emphasizing the critical role of gamification and mobile learning in contemporary language education (Crowther, Isbell, Kim, & Maloney, 2019). However, the limited number of studies focusing on writing skills suggested that Duolingo needs to be research more extensively in the context of production-based language skills. This does not necessarily imply that Duolingo is ineffective for writing skills; rather, it highlights a research gap regarding this specific skill.

Nevertheless, the relatively limited number of studies focusing on writing skills suggests that Duolingo may not sufficiently support deep learning in productive skills such as writing and speaking. In this respect, the findings of present study align with the effectiveness research conducted by Loewen et al. (2019), which reported that Duolingo facilitates measurable progress in second language (L2) learning, yet these gains may remain modest compared to the claims of commercial instructional materials. Furthermore, their study highlighted areas open to pedagogical development, noting that the application tends to rely heavily on independent learning, grammar-focused instruction, translation tasks, and audiolingual-style repetition exercises.

Supporting these findings, a peer-reviewed study conducted by Kim, Payant, Skalicky, and Namkung (2026) and published on Duolingo's official website revealed that the communication skills of Duolingo users learning French over the course of one semester reached a level comparable to that of students in a classroom setting. This finding indicates that Duolingo can function not only as a supplementary tool but also as an independent learning environment. The study reflects a growing trend in research comparing the effectiveness of app-based and classroom-based instruction in language learning, further reinforcing Duolingo's legitimacy within an academic context.

When the data provided by the examined studies are evaluated in general, it is understood that Duolingo is a multifaceted digital tool used in various contexts in language teaching.

In conclusion, it is observed that academic interest in Duolingo has increased between 2020 and 2025, with studies concentrated primarily on English language learning, mobile-assisted language

learning (MALL), vocabulary learning, and gamification. However, it is understood that research focusing on writing and speaking skills, different target languages, and the Turkish context remains limited. Furthermore, the fact that the majority of these studies rely on qualitative research designs indicates a need to support the application's learning outcomes with more quantitative data.

In light of these findings, the following recommendations are proposed:

- Future research may place greater emphasis on quantitative methodologies in order to evaluate Duolingo's learning outcomes through more robust and measurable data.
- The long-term effects of Duolingo on retention and sustained learning outcomes may be systematically investigated.
- Expanding research on different target languages would help demonstrate the effectiveness of Duolingo not only for English but also for other languages.
- Studies conducted with larger and more diverse samples in Türkiye may contribute to a more comprehensive understanding of the application's impact within the local educational context.
- Although Duolingo's gamification elements appear to enhance learner motivation, further in-app pedagogical developments may be needed to strengthen productive skills, particularly writing, which constitutes a core component of language proficiency.
- Additional research may explore how teachers can integrate Duolingo as a supplementary instructional tool within classroom practices, thereby enhancing its pedagogical functionality in formal learning environments.
- Finally, investigations may examine how Duolingo can be utilized beyond individual learning context and incorporated into collaborative learning environments. Integrating the application into group work, classroom-based practices, and online learning communities could further reinforce its social and interactive dimensions in language learning processes.

### **Additional Declaration**

#### ***Author Contributions***

In this study, the contribution of the authors was equal; both authors contributed equally to the development of the research idea, data analysis, writing and proofreading stages.

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This study was not funded by any institution or organization.

#### ***Responsible Artificial Intelligence Statement***

No artificial intelligence support was received in any part of this study.

### ***Conflicts of Interest***

The authors declare that there are no conflicts of interest related to the publication of this study.

### ***Ethics Approval***

This study does not require ethics committee approval as it does not involve any direct application on human or animal subjects.

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