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Article abstract

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Abstract

This study, which is quasi-experimental in nature, looks into how language learners' willingness to communicate and engagement in English as a foreign language (EFL) classrooms are affected by Duolingo. The control and experimental groups comprised two complete classes with forty EFL students. To compare learner engagement and communication willingness scores before and after treatment, the study used independent samples t-tests. The results demonstrated the groups' initial homogeneity by showing no discernible differences prior to the intervention. The results confirmed the effects on learner engagement, which showed significant gains in affective, cognitive, and behavioral domains, indicating Duolingo's beneficial impact on engagement in general. Furthermore, the significant effect sizes observed confirmed Duolingo's contribution to improved language attitudes, engagement, and communicative confidence. Compared to the control group, the experimental group's willingness to speak, read, write, comprehend, and communicate generally improved in a manner that was statistically significant. The significant effect sizes demonstrate how well Duolingo works to improve different aspects of willingness to share. The study emphasizes the pedagogical tool's adaptability and encourages teachers to integrate Duolingo for a comprehensive and technologically enhanced language learning experience. Practical implications arise for EFL teachers who use online learning resources.

Keywords: AI-integrated technology, AI, Duolingo, willingness to communicate, engagement, online class, EFL

Introduction

The rapid advancement of technology has drastically changed the way that languages are taught and acquired in today's ever-changing educational environment. Educators have access to cutting-edge methods and resources that stimulate students' curiosity and push their intellectual limits (Blake, 2013, 2016; Stanley, 2013). Acquiring new languages is made easier for learners by the abundance of authentic and creative resources (Walker & White, 2013). According to Larsen-Freeman and Anderson (2011), the use of technology in language education has improved learning experiences by giving students more access to the target language and letting them advance at their own speed. Technical resources such as podcasts, vodcasts, and online dictionaries are also being made available to teachers.

The Internet has become a change agent and a better means of education in the modern era of multimedia and the Internet (Adesote & Fatoki, 2013). Teachers need to embrace this change and be creative and inventive in order to keep up with the modern demands of education. Information and communication technology (ICT) has advanced as a result of the shift in educational tools and platforms from traditional approaches to technology-driven programs such as Memrise, Babbel, HelloTalk, and Duolingo (Yunus et al., 2009). In order to enable students to study anytime, anywhere, and at their convenience, mobile devices—such as laptops, tablets, smartphones, and other gadgets—play a vital role in education (Ogata & Yano, 2004; Yang, 2006). More than ten years ago, Keegan (2003) predicted that mobile learning (m-learning), a subset of e-learning, would influence education. Wagner (2005) noted that there is no denying the influence of mobile devices on different groups of people, indicating a mobile revolution in the field of education.

New smartphone apps are constantly improving language learning, making it more engaging and customized for users as technology advances. This essay examines the possibilities offered by the smartphone language learning app Duolingo (https://www.duolingo.com/) for acquiring a second language. Users who speak English have a choice of 16 languages, from French to Esperanto. Other language speakers, however, have fewer choices. While Spanish speakers have six language options and French speakers have four, English speakers can choose from 16 languages. In contrast to comparable apps like Babbel and Busuu, Duolingo offers a wider selection of languages despite this variability. This wide variety is a result of the diverse learning community on Duolingo as well as the platform's encouragement of user contributions, which promotes continuous expansion of the language courses that are offered.

The world's most popular language learning app, Duolingo, with over 300 million users, is the subject of this paper's exploration of mobile language learning. Specifically focused on teaching English as a second or foreign language, Duolingo is a game-based application that strives to make education free, enjoyable, and accessible. Duolingo uses technology to create a fully immersive and technologically advanced learning environment, including compatibility with computers and mobile phones. But even with Duolingo's extensive use, there is a noticeable lack of research on the precise effects of the app on the willingness to communicate (WTC) and general engagement of English as a foreign language (EFL) learners. Although Duolingo was shown to be beneficial in teaching vocabulary, grammar, and language proficiency in earlier research, a thorough investigation of the complex dynamics underlying learners' communication willingness and sustained engagement is still lacking. To close this gap, this paper examines how learners'

attitudes toward communication are shaped by Duolingo and how much attention it can generate. Two research questions were raised:

1. Does EFL learners' use of Duolingo affect their willingness to communicate in online classes?

2. Does EFL learners' use of Duolingo affect their engagement in online EFL classes?

Review of Literature

The study is mainly based on two leading theories. The first theory is a sociocultural and cultural theory, which posits a significant connection between an individual's psychology and the cultural and institutional context in which they are situated (Scott & Palincsar, 2013). As Ahmed (2017) articulated, culture encompasses inherited beliefs and practices that exert a substantial influence on the course of our lives. Central to this theory is the role of social interactions and cultural engagements in shaping psychological development. It underscores that development is not solely an internal process but is profoundly impacted by external social interactions. The surroundings in which individuals find themselves play a pivotal role in shaping behavior and learning. In this view, language mirrors and communicates the very fabric of culture.

Numerous contemporary domains of investigation and expression are increasingly reliant on and bolstered by computational resources. An emergent common ground has already materialized, encompassing artificial intelligence (AI), learning analytics, educational data mining, machine learning, and complexity theory (Dawson et al., 2018; Tsai et al., 2019).

Feng and Law's (2021) analysis of AI in education research from 2010 to 2019 highlighted a diverse range of research topics, primarily focused on intelligent tutorial systems and massive open online courses. Keywords such as neural networks, personalized learning, eye tracking, and deep learning were also prominent during that period. As AI capabilities continue to advance, AI systems are poised to become commonplace tools in activities such as article or essay writing, paper outlining, artistic creation, and collaboration on academic research projects. With the advent of state-of-the-art machine learning, particularly large language models (Huang et al., 2022; Zhou et al., 2022), AI agents may assume a significant role in these activities. These advancements prompt reconsideration of longstanding assumptions about learning, posing questions about granting degrees to individuals using AI systems, hiring graduates based on their knowledge and skills, and potential concerns about fairness and cheating.

In addition to potential harms, educators contemplating the incorporation of AI in education must navigate the overhyped potentials and pitfalls—an aspect referred to as "AI theatre" by Selwyn (2022), perhaps fueled in part by "enchanted determinism" (Campolo & Crawford, 2020). This notion implies the belief that technology possesses magical, superhuman powers to address educational shortcomings or rescue humanity from its own challenges. Our narrative seeks to avoid extremes of wishful thinking or alarmist rhetoric by recognizing that AI and its foundation in global big data enhance and amplify human thinking and performance, magnifying human potential.

As a magnifying tool, AI can either exacerbate negative aspects or enhance positive ones, necessitating careful and deliberate usage. All tools capable of enhancing human potential mediate the intentions of those employing them. For instance, steam engines and later, oil and gas burning engines, reduced labor costs for massive earth-moving projects, facilitating the construction of vast dams and cities. Nevertheless, they also brought about displacements, injuries, and unemployment. AI in education constitutes a double-edged sword with the potential for unintended consequences, prompting a reassessment of assumptions regarding learning, knowledge, skill, performance, creativity, and innovation. Essential to its positive use is the intention of those wielding power, exercised with caution and vigilance regarding consequential impacts (Gibson et al., 2023).

EFL learners enhance their language proficiency through interactions with native speakers and under mentorship (Adilbayeva et al., 2022). Digital communication platforms immerse learners in sociocultural environments, with the language used on these platforms significantly affecting language improvement. The depth of word meanings is gleaned through communication (Adilbayeva et al., 2022; Ahmed, 2017; Alibakhshi & Mohammadi, 2016). Peer interactions are equally crucial, guided by instruction as emphasized by the theory (Scott & Palincsar, 2013).

Willingness to Communicate

The concept of willingness to communicate (WTC) refers to individuals' willingness to engage in verbal interactions with specific individuals or groups using a second language (L2; MacIntyre et al., 1998). It can also be interpreted as a consistent inclination for discourse when given the freedom of choice (MacIntyre et al., 1998). Kruk (2019) extended this idea by suggesting that WTC reflects a learner's cognitive consideration in employing the target language for communicative purposes. In this context, MacIntyre and Vincze (2017) argued that WTC is the primary objective in foreign language acquisition, given its potential to encourage authentic communicative behavior and enhance proficiency in the L2. The comprehensive framework of WTC, as outlined by Öz, Demirezen, and Pourfeiz (2015), encompasses affective, sociopsychological, linguistic, and communicative aspects. This framework elucidates and predicts language learners' communicative tendencies within the L2 domain. MacIntyre et al.'s (1998) theoretical framework presented a threefold analysis of WTC, examining it through trait-oriented, dynamic, and contextual lenses.

The psychological aspect of WTC is closely linked with foreign language anxiety, self-confidence, and motivation (Dewaele & Dewaele, 2018). Conversely, the dynamic and contextual dimensions of WTC are intertwined with the socioenvironmental and situational elements of the learning process, including factors such as conversational partners (Lee & Hsieh, 2019) and collaborative peers (Zarei et al., 2019). Recent literature has emphasized that WTC is best understood as a dual-faceted construct, combining the learner's enduring traits and situational dispositions (Khajavy et al., 2019). This dual perspective underscores WTC's origin from stable learner traits, such as age, gender, and personality (MacIntyre & Charos, 1996), while acknowledging its susceptibility to fluctuation based on situational cues, including interlocutors, pedagogical methods, and thematic contexts (Zhang et al., 2018). Due to its close connection with learners' inclination to actively seek communicative opportunities and participate in interactive exchanges, WTC plays a crucial role in language acquisition.

A prevailing proposition in the L2 domain asserts WTC as a decisive determinant of L2 communicative behavior, thereby contributing to L2 proficiency (MacIntyre et al., 1998). Several studies have investigated WTC's ability to predict L2 communicative patterns, revealing a positive correlation between increased WTC and enhanced L2 engagement. Additionally, inquiries have examined the relationship between WTC and L2 competence, uncovering a constructive association between the two. More recently, scholarly investigations have highlighted that L2 performance depends on learners' WTC, transcending mere communicative behaviors.

Student Engagement

Emotional engagement refers to students' affirmative and adverse reactions towards peers, educators, educational institutions, and learning outcomes. Conversely, cognitive engagement is characterized by students' intellectual investment in and comprehension of subject matter, encompassing meticulous contemplation and a willingness to invest substantial effort in comprehending intricate concepts and mastering arduous skills (Fredricks & McColskey, 2012). The ramifications of academic engagement are manifold and enduring, encompassing endeavors such as pursuing advanced education, sustaining consistent learning habits, enhancing vocational opportunities, nurturing constructive self-conception and well-being, and mitigating symptoms of depression (Eccles & Wang, 2012). Consequently, dynamic involvement in academic pursuits engenders positive outcomes that transcend the confines of educational contexts. Furthermore, intellectual engagement evinces a robust nexus with academic motivation and performance, as students who actively participate in scholarly endeavors are inclined to accord higher evaluations to their studies, attain elevated scores, and evince diminished levels of academic disengagement and evasion (Li & Lerner, 2011).

Recently, engagement has garnered substantive consideration as a pivotal determinant of academic triumph (King, 2015). It is posited that positive emotions indirectly influence educational outcomes through motivational mechanisms, prominently exemplified by engagement (Gobert et al., 2015). In this paradigm, engagement is a pivotal driver of academic aspirations. Students who manifest keen interest are apt to channel augmented exertions toward academic tasks, culminating in successful task completion and increased academic performance (Ketonen et al., 2019). In professional milieus, engagement is understood as a mental state characterized by heightened vigor, unwavering dedication, and complete engrossment (Schaufeli et al., 2002). Vigor underscores heightened cognitive strength during work; dedication encapsulates a sense of self-value, enthusiasm, inspiration, pride, and challenge, while engrossment entails complete absorption and gratification in one's undertakings, leading to a swift passage of time. This conceptual framework has been transposed into the academic realm, focusing on students' academic tasks and activities (Appleton et al., 2006). Engaged students experience heightened vitality, a fervent attachment to their academic pursuits, and an active integration into their scholarly journey (Avcı & Ergün, 2022). Empirical substantiation buttresses the proposition that engaged university students exhibit enhanced academic performance (Zhou et al., 2010), with practical designs unveiling a positive correlation between engagement and educational attainment (Avcı & Ergün, 2022). Engagement correlates with elevated academic grades, scholastic accomplishment, and self-reported learning achievements (Zhou et al., 2010). Succinctly, engagement emerges as a pivotal catalyst for academic success, wherein affirmative emotional states catalyze augmented engagement, ultimately leading to enhanced academic performance. Engaged students are predisposed to channel escalated effort into their educational undertakings, thus

fostering triumphant task execution and elevated scholastic accomplishment. Therefore, educators are urged to cultivate academic engagement by developing a favorable pedagogical milieu, nurturing positive affective states, and fostering active participation in academic pursuits.

Studies on the Use of Duolingo

Studies have examined how Duolingo affects students' academic performance (Anugerahwati, 2016; Crompton, 2023; Poureau & Wright, 2013; Ratzlaff, 2015). These studies investigated multiple facets, including postsecondary students' accomplishments, attitudes, attributions, and language learning abilities (Bain et al., 2010); distinct case studies on the use of Duolingo as a tool for second language acquisition (Anugerahwati, 2023); and the advantages and difficulties of using Duolingo and other mobile learning resources (Crompton, 2013). Furthermore, studies on Duolingo's effectiveness compared to conventional language courses (Ratzlaff, 2015) and its integration into language education have been done (Munday, 2016). Additional relevant studies have looked at how gifted students perceive learning English as a foreign language (Okan & Işpınar, 2009), how Malaysian talented students struggle with language learning (Yunus, Sulaiman, Kamarulzaman, et al., 2013), and Malaysian gifted students' application of English language learning techniques (Yunus, Sulaiman, & Embi, 2013) The studies above enhance comprehension of how Duolingo, as a language learning aid, influences the accomplishments and encounters of students in various educational settings and learner types.

The previous related studies show that the use of Duolingo in EFL learning has greatly led to students' higher achievement in learning English (Alfuhaid, 2021; Arumsari & Octaviani, 2022; Habibie, 2020; Hakimantieq et al., 2022; Hernadijaya, 2020; Redjeki & Muhajir, 2021; Ünal & Güngör, 2021; Zheng & Fisher, 2023). According to the findings of earlier research, Duolingo is acknowledged for its numerous advantages; however, it is imperative to recognize the challenges it presents. Notably, Nushi and Eqbali (2017) asserted that one such challenge lies in the absence of direct human interaction within the Duolingo platform, emphasizing its primary focus on individual user development. Consequently, the enhancement of communication skills may not be optimally facilitated.

Building on this perspective, Perez (2020) underscored that the use of Duolingo necessitates a reliable Internet connection and compatible devices. However, a significant limitation arises from the unequal access to such technological facilities among students. This potential discrepancy has the capacity to give rise to challenges in the educational context (Irzawati, 2023).

The extant research collectively underscores both the merits and demerits associated with incorporating Duolingo into EFL instruction. To harness the benefits and mitigate potential drawbacks, users are advised to engage in proactive planning, address potential issues, and capitalize on available opportunities. A crucial element for users to wield Duolingo effectively in contributing to the success of language learning and teaching endeavors involves a comprehensive understanding of the platform's advantages and limitations (Irzawati, 2023).

Methodology

Sample and Procedure

A quasi-experimental research approach was used to investigate the effects of AI-infused technology, Duolingo, on the communication readiness and involvement of EFL learners. Specifically, a pretest/posttest control/experimental group research design was used. The quantitative data obtained from this design were analyzed using statistical methods.

Eighty first-year language learners from the Foreign Language Department of Hunan International Economics University in China participated in this study. The corresponding author was a researcher as well as a teacher there. Each participant was a native Chinese speaker pursuing a foreign language education in English. Chinese language proficiency and freshman enrollment at Hunan International Economics University were prerequisites for selection. Based on their capacity to give thorough and in-depth accounts of their experiences with the intervention, as well as their willingness to participate in semi-structured interviews, participants for the qualitative phase were selected. The sample sizes for the quantitative and qualitative phases of the study were 80 and 20, respectively, based on power analysis and study design. Using a pretest/posttest control/experimental group research design, the quantitative phase employed a sample size calculation to ensure adequacy.

Instrumentation

The present investigation employed two instruments to gather data: a learner engagement scale and the WTC scale. The interview checklist functioned as a qualitative measure, and the WTC and Foreign Language Classroom Anxiety (FLCA) scales as quantitative measures. We used an assessment tool adapted from MacIntyre et al. (1998) to measure the WTC of English language learners. Participants indicated their degree of agreement or willingness on a 5-point scale for each of the 27 items in this tool. Responses ranged from 1 (*almost never willing*) to 5 (*almost always willing*). The Cronbach's alpha coefficient was employed to evaluate items' internal consistency. With Cronbach's alpha for each dimension exceeding 0.78, the findings demonstrated a high degree of internal consistency and the scale's consistency in measuring the intended construct.

The Student Engagement Scale, a self-report instrument used to assess students' participation in class activities, was the second tool used. This scale was developed and validated by Fredricks and McColskey (2012). Three aspects of engagement were assessed using this scale: behavioral, cognitive, and affective enjoyment. Higher scores on this scale indicated higher levels of engagement. The range of scores was 12 to 60. The internal consistency of the scale was estimated using Cronbach's alpha, and the estimated alpha for each component exceeded 0.80, indicating that the instrument enjoyed an acceptable level of internal consistency.

Procedure

We employed a quasi-experimental research method to investigate the effectiveness of an intervention (use of Duolingo) designed to increase language learners' willingness to communicate in English and engagement in learning processes. First, the study was conducted through a structured series of steps, ensuring a systematic approach. Second, learners were randomly assigned to either the control or

experimental group after screening and obtaining consent. Third, before any intervention, participants' baseline WTC and engagement levels were measured through validated pretest instruments. These instruments assessed participants' comfort and readiness to communicate in English and their motivation and involvement in learning activities. Fourth, following placement tests, the participants in the experimental group were instructed to engage with Duolingo for a minimum of 30 minutes every day over two months. Additionally, they were tasked with providing daily voice messages detailing their perceptions of progress after each session. The participants conscientiously shared with us screenshots showing their daily advancements. Notably, there needed to be a stipulation for the participant to complete a specific set of lessons or skills; instead, they had the autonomy to decide when they had sufficiently grasped the necessary knowledge. The approach encouraged participants to study at their current proficiency level, progress at their pace, and establish their learning strategies, whether these involved moving forward, revisiting topics, or maintaining a consistent practice. Finally, after the intervention, participants' WTC and engagement levels were once again measured, this time through validated posttest instruments.

Data Analysis

The collected information, which included the experimental and control groups' pretest and posttest results, was subjected to a number of statistical analyses. To provide a summary of participants' initial levels of engagement and communication as well as any changes after the intervention, descriptive statistics such as means, standard deviations, and frequency distributions were first computed. The significance of the observed differences was then evaluated using inferential statistical techniques. To find out if the changes seen in the experimental group were significantly different from those in the control group, several independent samples t-tests were run.

Results

Research Question 1

The first research question was designed to investigate the effects of Duolingo on language learners' engagement in classroom activities. The groups' scores on learner engagement and its components before and after the treatment were submitted to independent samples t-tests. The results of t-tests on learner engagement before the treatment are presented in Table 1.

Table 1

Results of t-*Tests Examining Learner Engagement: Pretest*

Type of engagement	Control		Experimental		Independent samples *t*-tests		
	M	*SD*	*M*	*SD*	*t*	*df*	*p*
Affective	3.30	1.1	3.43	0.88	0.99	78	.28
Cognitive	3.20	0.97	3.27	1.07	-1.4	78	.37
Behavioral	3.35	0.85	3.20	0.88	1.45	78	.15
Total engagement	3.33	2.60	3.35	2.95	1.92	78	.29

The results indicate that with regard to affective engagement the experimental group scored slightly higher (than the control group. The groups did not differ significantly at the beginning of the study (t (78) = 0.99, p = .28). When it came to cognitive engagement, the *t*-test produced a non-significant result (t (78) = -1.4, p = .37), indicating that there was no discernible difference between the experimental (M = 3.27, SD = 1.07) and control group (M = 3.20, SD = 0.97) at the beginning of the study. The *t*-test result for behavioral engagement was not statistically significant (t (78) = 1.45, p = .15), meaning that there was no discernible difference in behavioral engagement between the groups at the start of the study. There was no statistically significant difference in the groups' scores for the variable engagement (total), indicating that the groups were similar in terms of learner engagement and its constituent parts (t (78) = 1.92, p = .29). In Table 2, the posttest results are displayed.

Table 2

Results of t-*Tests Examining Learner Engagement: Posttest*

Type of engagement	Control		Experimental		Independent samples t-tests			
	M	*SD*	*M*	*SD*	*t*	*df*	*p*	Cohen's *d*
Affective	3.43	0.90	4.20	1.00	12.3	78	.001	0.66
Cognitive	3.40	0.96	4.30	1.1	13.2	78	.001	0.95
Behavioral	3.45	0.85	4.35	1.30	14.3	78	.001	0.88
Total engagement	10.28	2.91	12.85	3.35	13.2	78	.001	2.03

As shown in Table 2, the experimental group (M = 4.20, SD = 1.00) exhibited notably higher levels of affective engagement than the control group (M = 3.43, SD = 0.90). This difference proved highly significant (t = 12.3, df = 78, p < .001), signifying a substantial increase in affective engagement attributable to the intervention. Additionally, a statistically significant disparity was observed in cognitive engagement between the experimental group (M = 4.30, SD = 1.1) and the control group (M = 3.40, SD = 0.96), as indicated by the *t*-test (t = 13.2, df = 78, p = .001). Thirdly, a remarkable augmentation in behavioral engagement was evident in the experimental group (M = 4.35, SD = 1.30) compared to the control group (M = 3.45, SD = 0.85). The *t*-test result was highly significant (t = 14.3, df = 78, p < .001), underscoring the intervention's substantial impact on behavioral engagement. Finally, the total learner engagement score for

the experimental group (M = 12.85, SD = 3.35) surpassed that of the control group (M = 10.28, SD = 2.91). The t-test statistic was highly significant (t = 13.2, df = 78, p < .001), confirming a substantial positive effect of the intervention on overall learner engagement.

We compared effect sizes for each aspect to investigate the consistency of outcomes regarding learner engagement and its components through implementing digital communication activities. The results revealed that digital communication activities moderately affected EFL learners' affective engagement (Cohen's d = 0.66); however, there was a significant effect on other aspects of engagement (behavioral and cognitive) as well as the overall engagement (Cohen's d > 0.80).

Research Question Two

The impact of Duolingo on language learners' readiness to interact in the classroom was measured in response to the second research question. Independent samples t-tests were performed using the groups' WTC scores, both before and after the treatment, and its components. Table 3 displays the findings of t-tests for the groups' WTC scores prior to the intervention.

Table 3

Results of t-*Tests Examining Willingness to Communicate: Pretest*

WTC variable	Control		Experimental		Independent samples t-tests		
	M	*SD*	*M*	*SD*	t	*df*	*p*
Speaking in class	25.1	3.10	24.00	2.40	0.82	78	.15
Reading in class	17.3	4.20	18.00	3.50	0.93	78	.27
Writing in class	22.3	2.00	23.00	2.00	0.80	78	.21
Comprehension	13.2	4.10	13.00	2.10	1.40	78	.19
Total WTC	77.9	13.30	78.00	13.20	2.20	78	.41

Note. WTC = willingness to communicate.

When it came to reading in class, the experimental group scored an average of 18 points (SD = 3.5), while the control group scored an average of 17.3 points (SD = 4.20). The t-test produced a non-significant result (t (78) = 0.93, p = .27), suggesting that there was no statistically significant difference in the control and experimental groups' willingness to read at the start of the study. In terms of writing assignments for class, the experimental group showed a somewhat higher mean score of 23 (SD = 2.00) than the control group, which showed a mean score of 22.3 (SD = 2.00). The results of the t-test showed a non-significant difference (t (78) = 0.80, p = .21), indicating that at the beginning of the study, there was no significant difference between the two groups' willingness to write in class. The experimental group produced a mean score of 13 (SD = 2.10) for comprehension, while the control group's mean score was 13.2 (SD = 4.10). At the beginning of the study, there was no discernible difference in comprehension between the control and experimental groups, according to the non-significant result of the t-test (t (78) = 1.40, p = .17). The experimental group recorded a slightly lower mean score of 84.9 (SD = 13.20) than the control group, which recorded a mean score of 88.00 (SD = 13.30) regarding the WTC (total). The lack of a significant difference at the start of the study in the t-test result (t (78) = 2.1, p = .31) indicates that the result did not reach statistical significance.

Results of the independent samples *t*-tests to compare posttest scores between the groups for various aspects of their WTC is shown in Table 4.

Table 4

Results of t*-Tests Examining Willingness to Communicate: Posttest*

WTC Variable	Control		Experimental		Independent samples *t*-tests			
	M	*SD*	*M*	*SD*	*t*	*df*	*p*	Cohen's *d*
Speaking in class	23.60	3.33	32.3	3.66	12.39	78	.001	1.9
Reading in class	18.60	4.13	24.39	4.16	13.29	78	.001	1.4
Writing in class	24.50	2.3	27.00	2.4	14.3	78	.001	1.13
Comprehension	12.70	4.20	18.53	2.35	10.6	78	.001	1.69
Total WTC	79.40	13.9	107.8	12.4	14.61	78	.001	2.20

Note. WTC = willingness to communicate.

The comparison of the experimental group (*M* = 32.3, *SD* = 3.66) and control group (*M* = 23.6, *SD* = 3.33) regarding willingness to speak showed a statistically significant difference, as shown in Table 4. When comparing the experimental group to the control group, the *t*-test result (*t* (78) = 12.39, *p* = .001) showed a significant increase in the effect size (Cohen's *d* = 1.9). Moreover, a significant distinction was observed in the experimental group (*M* = 24.39, *SD* = 4.16) and control group (*M* = 18.60, *SD* = 4.13) with regard to willingness to read. There was a significant difference in the effect size (Cohen's *d* = 1.40) between the experimental and control groups, as indicated by the *t*-test (*t* (78) = 13.29, *p* = .001). The experimental group (*M* = 27, *SD* = 2.4) showed statistically significant improvement in willingness to write compared to the control group (*M* = 24.5, *SD* = 2.3). The experimental group appears to have had significantly higher writing engagement, as suggested by the substantial effect size (Cohen's *d* = 1.13) indicated by the *t*-test (*t* (78) = 14.3, *p* = .001). Also, a noteworthy distinction can be seen in the experimental group's (*M* = 18.53, *SD* = 2.35) and control group's (*M* = 12.7, *SD* = 4.20) performance on the WTC comprehension scale. There was a significant difference in the effect size (Cohen's *d* = 1.69) between the experimental and control groups, as demonstrated by the *t*-test (*t* (78) = 10.6, *p* = .001).

Discussion

Investigating how Duolingo affected language learners' participation in classroom activities—with a particular emphasis on affective, cognitive, and behavioral engagement—provided insightful information. There were no statistically significant differences found between the control and experimental groups in Table 1's pretest score analysis across different engagement dimensions, suggesting homogeneity at the start of the study. It appears that any subsequent differences can be attributed to the effects of Duolingo, as there were no significant differences in affective, cognitive, behavioral, or total engagement prior to the intervention. When looking at the posttest scores in Table 2, it is evident that the experimental group had significantly higher engagement levels overall than the control group. As assessed by students' emotional involvement, affective engagement showed a significant improvement (Cohen's *d* = 0.66), suggesting that Duolingo had a beneficial effect on students' emotional attachment to the language learning process. This

result is consistent with studies (Blake, 2013; Crompton, 2013) that highlight the contribution of technology, like apps such as Duolingo, to the development of favorable affective outcomes in language learning.

Similarly, cognitive engagement, reflecting learners' mental investment in language learning activities, substantially improved in the experimental group (Cohen's d = 0.95). This result is consistent with studies emphasizing the cognitive benefits of technology in language education (Carneiro & Simao, 2011; Klopfer et al., 2002). The positive impact on cognitive engagement supports the notion that Duolingo's interactive features and gamified elements contribute to heightened cognitive involvement (Blake, 2016). Behavioral engagement, representing learners' active participation in language learning tasks, showed a remarkable increase in the experimental group (Cohen's d = 0.88). The statistically significant improvement suggests that Duolingo effectively promotes learner involvement and participation in language-related activities (Thornton & Houser, 2005; Vesselinov & Grego, 2012).

The total learner engagement score also revealed a substantial positive effect of Duolingo (Cohen's d = 2.03). This comprehensive measure suggests that integrating Duolingo into language instruction significantly enhances engagement. The effect size's magnitude underscores the intervention's practical significance (Fredricks & McColskey, 2012). In summary, the results indicate that Duolingo positively influences language learners' engagement in classroom activities, encompassing affective, cognitive, behavioral, and total engagement. These findings align with previous research highlighting the potential of technology, specifically Duolingo, in enhancing various dimensions of engagement in language learning contexts.

Next, we look at how Duolingo affects language learners' WTC in the classroom. The findings (tables 3 and 4) offer important new information about how the intervention affects various facets of communication. There were no discernible variations in WTC between the control and experimental groups in speaking, reading, writing, comprehension, or overall willingness to communicate, according to the pretest analysis shown in Table 3. This initial homogeneity implies that the intervention can be held responsible for any changes in learners' willingness to communicate in future. When comparing the experimental group to the control group, there was a noticeable increase in communication willingness, as indicated by the analysis of the posttest scores shown in Table 4. The experimental group was substantially more willing to speak in class (Cohen's d = 1.9), highlighting Duolingo's beneficial effects on oral communication. This result is in line with studies showing how well technology can improve speaking abilities (Blake, 2013; Klopfer et al., 2002). The experimental group showed a significantly higher willingness to read aloud in class (Cohen's d = 1.4). This finding is consistent with research showing how technology, particularly language learning applications, can increase reading engagement (Lee & Hsieh, 2019; Stanley, 2013). The experimental group showed noticeably higher willingness to write in class.

The experimental group's total WTC score was substantially higher than the control group's (Cohen's d = 2.2). According to this thorough assessment, Duolingo significantly improves students' willingness to interact with one another in the classroom. Research by Zhang, Beckmann, and Beckmann (2018) adds credence to these conclusions by indicating that digital communication activities significantly increase learners' willingness to communicate. The study highlights how technology can help language learners create a supportive environment that increases their confidence and drive to share. Furthermore,

Mystkowska-Wiertelak and Pawlak (2017) emphasized the connection between affective, cognitive, and contextual factors that affect communication willingness. The results of this study support this viewpoint since Duolingo's influence on learners' affective and cognitive engagement in the context of language learning increases their willingness to communicate. The study's findings prove that Duolingo positively impacts language learners' participation in class activities and openness to communication. The results are consistent with other studies showing how technology—especially Duolingo—can improve communication and engagement in language learning environments. The significant effect sizes are seen in several dimensions.

Conclusion and Implications

The study's findings shed light on how Duolingo has a revolutionary effect on language learners' willingness to communicate and participate in class activities. Significant gains in affective, cognitive, and behavioral engagement, as well as an increased willingness to speak, read, write, comprehend, and communicate in general, are consistently shown in the results. The results highlight Duolingo's efficacy as a flexible instrument for language learning and are consistent with recent studies that support the use of technology in language learning. The significant effect sizes observed in various engagement and communication dimensions underscore Duolingo's capacity to incite favorable transformations in language learners' perspectives, involvement, and communicative assurance. Duolingo has surfaced as a helpful ally in creating a rich and dynamic language learning environment as educators look for new ways to involve students and support efficient language acquisition. The study's implications go beyond the immediate context to encompass more general language education issues. Above all, the favorable results highlight how important it is for teachers to use technology wisely. Duolingo is a prime example of how digital platforms can improve student engagement and communication skills. Including Duolingo in language courses could benefit teachers who want to create a vibrant and welcoming learning environment.

Acknowledgements

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