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Tech-Enhanced Language Education in Pakistani Public Schools: A Holistic Overview of Duolingo

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Abstract

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Pakistan's public schools educate a large proportion of the country's children but often operate with limited digital infrastructure, uneven teacher preparation, and persistent disparities in English-language learning. This integrative narrative review examines whether Duolingo could serve as a supplementary English-learning resource in this context. It synthesizes the manuscript's corpus of 40 studies—33 journal articles, three conference papers, and four theses or dissertations—on Duolingo and related digital-language-learning practices, together with Pakistan-focused literature on public-school quality, information and communication technology (ICT), teacher readiness, and access. The reviewed evidence generally associates Duolingo's gamified practice, immediate feedback, adaptive sequencing, and mobile accessibility with increased motivation, vocabulary development, speaking practice, and learner autonomy. However, most effectiveness studies were conducted outside Pakistani public schools and frequently involved older or better-resourced learners. Pakistan-specific evidence points to major implementation constraints, including unreliable connectivity and electricity, limited device access, data costs, insufficient teacher training, curriculum misalignment, and weak institutional support. Accordingly, system-wide integration is not presently justified. A more feasible approach is a phased, teacher-mediated pilot in selected schools, accompanied by infrastructure support, localized content, safeguarding measures, and independent evaluation of learning outcomes and equity effects. The review concludes that Duolingo may be useful as a supplementary tool, but it cannot substitute for trained teachers, curriculum reform, or sustained public investment.

Keywords: Duolingo; English language learning; public schools; educational technology; digital divide; Pakistan; gamification

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1. INTRODUCTION

Pakistan's public-school system serves approximately 53.5% of the country's enrolled students, many of whom come from low-income households (Pakistan Institute of Education, 2022). These schools frequently face shortages of instructional resources, uneven teacher preparation, and limited access to digital technologies. Such constraints are especially consequential for English-language learning because English remains important in higher education, formal employment, public administration, and social mobility.

Digital language-learning platforms are often presented as a means of widening access to practice and feedback. Duolingo is particularly visible because it offers a free tier, short gamified lessons, adaptive sequencing, speech-recognition activities, and immediate feedback. Nevertheless, accessibility at the level of an individual smartphone user should not be confused with feasibility at the level of an under-resourced school system. Effective adoption depends on devices, connectivity, electricity, teacher mediation, curricular alignment, age-appropriate use, data protection, and sustained institutional support.

Previous research has examined Duolingo in diverse national and educational settings, while a separate body of Pakistani research documents disparities between public and private schools and weaknesses in ICT provision. These two evidence bases are rarely considered together. This review therefore evaluates Duolingo's educational potential alongside the structural conditions that would determine whether it could be used equitably and effectively in Pakistani public schools.

1.2. Objectives and Research Questions

The study has three objectives:

1. To synthesize evidence on Duolingo's contribution to English-language learning, engagement, and learner autonomy.
2. To identify the principal infrastructural, socioeconomic, pedagogical, and policy barriers to technology integration in Pakistani public schools.
3. To assess the short- and long-term feasibility of using Duolingo as a supplementary classroom resource in these schools.

These objectives are addressed through the following research questions:

RQ1: What learning-related benefits and limitations are reported in the Duolingo literature?

RQ2: What conditions constrain the adoption of digital language-learning tools in Pakistani public schools?

RQ3: Under what conditions, if any, would a Duolingo-supported intervention be feasible and equitable?

1.3. Conceptual Framework

Three complementary perspectives guide the synthesis. Constructivist learning theory emphasizes active participation, feedback, and the gradual construction of knowledge through practice. Self-determination theory highlights autonomy, competence, and motivation, which are relevant to self-paced learning and visible progress. Research on gamification examines how points, streaks, levels, and challenges may sustain engagement. These perspectives help explain why learners may respond positively to Duolingo. They do not, however, establish effectiveness

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on their own; learning outcomes also depend on instructional design, teacher support, learner characteristics, and access conditions.

2. METHODOLOGY

2.1 Review Design

The study is an integrative narrative review of secondary sources. This designation is used because the evidence includes heterogeneous journal articles, conference papers, theses, institutional reports, and comparative studies, and because no statistical meta-analysis was conducted. The approach enables the comparison of international evidence on Duolingo with Pakistan-specific evidence on school quality and technology readiness.

2.2 Evidence Base and Selection Logic

The source manuscript assembled 40 Duolingo-focused studies: 33 journal articles, three conference papers, and four theses or dissertations. Studies were retained when they directly examined Duolingo, mobile-assisted language learning, gamification, learner engagement, vocabulary, speaking, listening, autonomy, or closely related outcomes. Pakistan-focused sources were used when they addressed public–private school disparities, English-language learning, ICT access, teacher readiness, infrastructure, or policy conditions relevant to implementation.

2.3 Analytical Procedure

The evidence was organized into two analytical domains. The first covered reported learning benefits and limitations of Duolingo, including motivation, vocabulary, speaking, listening, feedback, autonomy, and engagement. The second covered implementation conditions in Pakistan, including devices, internet access, electricity, affordability, teacher capacity, curriculum alignment, and governance. Findings were then interpreted through the conceptual framework and used to develop a feasibility judgement.

2.4 Methodological Limitations

The original evidence set did not document a fully reproducible database search, screening flow, or formal quality-appraisal procedure. The review may therefore be affected by selection and publication bias. The included studies also vary in age group, language target, duration, research design, and educational setting. Most were not conducted in Pakistani public schools; consequently, their findings indicate potential rather than direct proof of effectiveness in the target context.

3. FINDINGS

3.1 Reported Benefits of Duolingo

Across the reviewed literature, Duolingo is most consistently associated with learner engagement and regular practice. Its short lessons, progress indicators, rewards, streaks, and adaptive difficulty can make practice more visible and manageable. Studies report positive learner perceptions and increased motivation, particularly among beginners and learners using the app as a supplement rather than as a complete course (Ajisoko, 2020; Habibie, 2020; Lahji, 2024; Sari et al., 2023).

Vocabulary development is another recurring outcome. Repeated exposure, retrieval practice, and immediate correction can support vocabulary learning, especially when use is structured and sustained (Febrianti et al., 2024; Ilyas et al., 2023; Rouabhia & Kheder, 2024). Several studies also report gains in speaking confidence, pronunciation, fluency, or willingness to

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communicate, although the strength of evidence varies across designs (Alfuhaid, 2021; Fitria et al., 2023; Kazu & Kuvvetli, 2024; Ouyang et al., 2024).

The app may also support learner autonomy by allowing students to practise at their own pace and receive immediate feedback outside conventional classroom time (Dhari & Syafryadin, 2024; Qiao & Zhao, 2023). This potential is consistent with self-determination theory, particularly the needs for competence and autonomy. Teacher guidance remains important, however, because app-based exercises may not adequately address local curricular objectives, extended communication, or higher-order literacy.

3.2 Limitations of the Duolingo Evidence

The evidence base does not support the claim that Duolingo can independently deliver comprehensive language proficiency. Many studies use small samples, short interventions, self-reported perceptions, or institution-specific designs. The app is generally more effective for discrete practice—such as vocabulary, sentence-level grammar, pronunciation, and routine engagement—than for extended writing, spontaneous interaction, culturally situated communication, or subject-specific English. Some studies also note content limitations and the need to combine Duolingo with teacher-led instruction and other materials (Loewen et al., 2019; Shortt et al., 2023; Yundayani et al., 2023).

Transferability is a further concern. Much of the literature involves university students, secondary learners, or users with personal devices and reliable internet. These conditions differ markedly from many Pakistani public primary and secondary schools. Positive findings should therefore be treated as evidence of possible educational value, not as proof that large-scale implementation would succeed in Pakistan.

3.3 Global Digital Language-Learning Trends

The Duolingo Language Report (2023) illustrates the scale and diversity of voluntary digital language learning. English remained the most studied language in 122 countries, while Korean, Portuguese, and Ukrainian reflected cultural, mobility, and geopolitical influences. These trends show that app-based learning can respond rapidly to learner interests, but they do not constitute evidence of school-level effectiveness.

Table 1

Selected trends reported in the Duolingo Language Report (2023)

Trend	Illustrative evidence	Interpretive relevance
English demand	Ranked first in 122 countries	Confirms sustained demand for English linked to education and employment.
Culture-driven learning	Korean rose globally, including strong growth in India	Shows that motivation is shaped by popular culture and perceived opportunity.
Mobility and geopolitics	Portuguese and Ukrainian gained attention in several regions	Digital learning patterns respond quickly to travel, migration, and political events.
Generational variation	Younger users explored less commonly studied languages; older users maintained longer streaks	Engagement patterns vary by learner group and should not be generalized.

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3.4 Barriers in Pakistani Public Schools

Pakistan-focused studies consistently describe a substantial resource and quality gap between many public and private schools. Private institutions often benefit from more structured academic planning, better facilities, and stronger access to learning resources, although socioeconomic selection also contributes to observed differences (Alam et al., 2021; Kanwal & Ajmal, 2015; Siddiqui & Gorard, 2017). Public-school learners may also receive less vocabulary exposure and face greater comprehension and retention difficulties (Jamil et al., 2014; Jamil et al., 2024).

For digital learning, the principal barriers are material. Many schools lack sufficient computers or tablets, reliable broadband, stable electricity, technical support, and budgets for maintenance. Household-level access is equally uneven: students from low-income families may not own smartphones or may be unable to afford regular mobile data. These constraints create a risk that an app-based intervention could widen rather than reduce inequality.

Teacher readiness is another decisive factor. A digital platform does not integrate itself into pedagogy. Teachers require practical training in selecting appropriate activities, monitoring learner progress, supporting struggling students, protecting children's data, and linking app exercises to the prescribed curriculum. Resistance to technology may reflect not only attitude but also workload, weak support, and previous exposure to poorly sustained initiatives.

Language and curriculum alignment also matter. Learners with limited English may struggle to navigate instructions or infer task requirements. In addition, a global platform may not match Pakistan's grade-level outcomes, textbook sequence, cultural examples, or assessment practices. Without localization and clear policy guidance, adoption is likely to remain fragmented.

4. DISCUSSION

4.1 Educational Value: Supplement, Not Substitute

The reviewed evidence supports a limited but meaningful conclusion: Duolingo can provide additional opportunities for practice, feedback, and motivation, particularly for vocabulary, pronunciation, sentence-level grammar, and routine engagement. Its value is greatest when it supplements teacher-led instruction. It should not be treated as a replacement for qualified teachers, communicative classroom practice, reading and writing instruction, or a coherent English curriculum.

4.2 Feasibility in the Short and Long Term

Short-term, system-wide integration is not feasible across underperforming public schools because the minimum enabling conditions are uneven. A national mandate without devices, connectivity, electricity, teacher preparation, technical support, and evaluation would likely produce inconsistent use and reinforce existing inequalities.

Longer-term feasibility is conditional. Duolingo could be tested in schools that meet basic readiness criteria and where the app is embedded in a structured instructional plan. Public–private partnerships may support devices or connectivity, but governance must remain transparent and educational priorities should not be determined by platform availability alone.

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4.3 A Phased Implementation Model

Phase 1—Readiness assessment: identify schools with adequate electricity, secure devices, connectivity, technical support, and willing teachers.

Phase 2—Teacher preparation: provide hands-on training, lesson-integration guides, child-safeguarding protocols, and procedures for monitoring progress.

Phase 3—Localized pilot: align a limited set of Duolingo activities with grade-level outcomes and provide alternatives for students without home access.

Phase 4—Independent evaluation: compare learning outcomes, participation, teacher workload, costs, and equity effects against an appropriate comparison group.

Phase 5—Scale or discontinue: expand only when evidence shows educational benefit, affordability, and no widening of access gaps.

5. IMPLICATIONS FOR POLICY AND PRACTICE

- Infrastructure investment should precede or accompany platform adoption; software cannot compensate for absent devices, electricity, or connectivity.
- Teacher development should focus on pedagogical integration rather than one-time technical orientation.
- Digital activities should be mapped to national and provincial curricula, textbooks, assessment expectations, and local language needs.
- Access plans should prevent exclusion of students who lack personal devices or affordable data.
- Pilot programmes should collect evidence on learning, attendance, motivation, teacher workload, privacy, cost, and distributional effects.
- Procurement and partnerships should include clear data-governance, child-safeguarding, transparency, and exit provisions.

6. LIMITATIONS

This review is limited by the heterogeneity and uneven quality of the included studies and by the absence of a fully documented systematic search and quality-appraisal process in the original source set. The evidence is weighted toward non-Pakistani settings and older learners, which restricts direct generalization to public-school children in Pakistan. The review also evaluates feasibility conceptually; it does not provide primary classroom data, cost-effectiveness estimates, or a technical audit of school infrastructure. These gaps should be addressed through carefully designed local pilot studies.

7. CONCLUSION

Duolingo has potential as a supplementary English-language learning tool because its gamified practice, adaptive feedback, and mobile format can support engagement, vocabulary development, speaking practice, and learner autonomy. The evidence does not show that it can replace teachers or resolve the structural weaknesses of Pakistan's public-school system. In the present context, large-scale implementation would be premature. The most defensible course is a phased, teacher-mediated, curriculum-aligned pilot in schools that meet minimum readiness conditions, followed by independent evaluation. Sustainable improvement in English learning will

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ultimately depend on trained teachers, equitable infrastructure, coherent policy, and continued public investment rather than on any single platform.

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Appendix A

Summary of the Duolingo Evidence Corpus

The table below preserves the evidence map supplied in the original manuscript. Bibliographic details marked as incomplete in the source should be verified before journal submission.

No.	Study	Source	Focus	Themes and patterns	Synthesis
1	Ouyang, Jiang & Liu (2024)	Journal article (IRRODL)	EFL engagement & communication	AI integration boosts motivation & active participation.	A dynamic tool for tech-enhanced language learning.
2	Oh (2024)	Bachelor's thesis	L2 acquisition in Malaysian tertiary	Ease of use, usefulness, & social influence drive effectiveness.	Social factors crucial for improved language outcomes.
3	Shinde (2024)	Journal article	Comparative analysis of language apps	AI tools offer varied strengths; combined use may overcome limits.	Integrated approach yields well-rounded language skills.
4	Qiao & Zhao (2023)	Journal article	AI instruction in Chinese EFL	Duolingo enhances speaking skills & self-regulation via AI.	AI-driven methods foster autonomy and speaking fluency.
5	Katiyar (2024)	Journal article	Personalized AI learning systems	Tailored instruction optimizes outcomes; ethical design matters.	Personalized AI holds transformative promise in education.
6	Ahmed (2016)	Journal article	Bilingual learning for beginners	Simultaneous language acquisition supported by Duolingo.	Effective for beginners, with room to grow for advanced users.
7	McMahon (2021)	Conference paper	Bilingual case study	Supports simultaneous language learning with basic success.	Solid for early learning, but needs enhancement for depth.
8	Lahji (2024)	Journal article	High school English motivation	Interactive, gamified features significantly boost motivation.	A compelling catalyst for engaging classroom learning.
9	Zhao et al. (2024)	Journal article	Willingness to communicate (WTC)	Duolingo (with HelloTalk) raises WTC, with slight Duolingo edge.	Effective in promoting communicative confidence in learners.
10	Wulandari & Halim (2024)	Journal article	Language retention & achievement	Gamified approach correlates with improved retention & outcomes.	A promising catalyst for academic and language success.
11	Coquis-Flames et al. (2024)	Journal article	Korean language platforms	Critical evaluation of features; highlights strengths & gaps.	Informs platform choice based on learner needs and skills.
12	Bharavi et al. (2024)	Journal article	AI for pronunciation accuracy	Real-time error detection and personalized correction shine.	AI tools redefine pronunciation training with precision.
13	Nugraha et al. (2023)	Journal article	English learning media tool	Qualitative insights confirm significant improvement in acquisition.	Duolingo acts as a valuable online medium for language growth.
14	Kherazi & Bourray (2024)	Conference paper	Gamification & mobile learning	Merging gamification with m-learning supports sustainable progress.	A revolutionary blend for ongoing, engaging language education.
15	Kazu & Kuvvetli (2024)	Journal article	Mobile game-based speaking improvement	Game mechanics drive speaking proficiency	Gamified strategies are key to modern mobile language success.

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No.	Study	Source	Focus	Themes and patterns	Synthesis
				through engaging practice.	
16	Kastelli & Takács (2023)	Master's thesis	Persuasive design & user engagement	Persuasive elements enhance retention but have room for refinement.	Design tweaks can further boost user engagement and retention.
17	Loewen et al. (2019)	Journal article	Turkish learning case study	Time spent correlates with gains; challenges in content remain.	Consistent use yields gains despite instructional hurdles.
18	Smith (2024)	Journal article	Spanish course for English speakers	Multi-skill improvements in vocabulary, grammar, and pronunciation.	Duolingo shows robust gains over a short, intensive period.
19	Alfuhaid (2021)	Journal article	EFL speaking in Saudi schools	Enhanced speaking skills and reduced anxiety noted with use.	A practical tool to transform secondary EFL speaking proficiency.
20	Fitria, Usman & Sahara (2023)	Journal article	English speaking skills	Notable improvements across vocabulary, grammar, and fluency.	A versatile app that significantly sharpens speaking abilities.
21	Muharral (2023)	Thesis	Speaking enhancement at SMP level	Pre/post test gains demonstrate clear improvement with Duolingo.	Validates Duolingo as an effective tool for speaking skill development.
22	Budiyanto & Ridho (2024)	Journal article	Eighth-grade speaking proficiency	Quasi-experimental design shows strong positive speaking outcomes.	Empirical evidence endorses Duolingo for middle school language growth.
23	Yundayani, Suseno & Herlina (2023)	Journal article	ESP skills assessment	Boosts engagement and vocabulary; lacks specialized content.	Useful for assessment, yet best paired with content-specific tools.
24	Kusuma et al. (2024)	Journal article	Out-of-class speaking enhancement	Significant improvements in fluency, accuracy, and pronunciation.	A strong supplementary medium for continuous language practice.
25	Stevani (2024)	Journal article	University language skills	Impacts listening, speaking, reading, & writing with engaging use.	Promising as a supplementary tool for comprehensive language skills.
26	Bungai et al. (2023)	Journal article	Young learners' mobile-assisted learning	Duolingo's interactive nature increases engagement among young learners.	A modern, accessible gateway for early language education.
27	Dhari & Syafryadin (2024)	Journal article	Self-directed language learning	Enhances motivation and time management via independent use.	Validates self-directed strategies with Duolingo's adaptable design.
28	Kumari (2024)	Conference paper	21st-century English language skills	Gamified interface promotes vocabulary, grammar, and fluency.	A forward-thinking tool that champions autonomous learning.
29	Hafifah (2021)	Journal article	Bilingual school speaking skills	Duolingo outperforms traditional methods in speaking improvement.	Strong evidence for digital methods over textbook-based instruction.
30	Febrianti et al. (2024)	Journal article	Vocabulary acquisition in higher ed	Interactive features markedly boost vocabulary skills.	An effective, engaging alternative for tertiary vocabulary learning.

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No.	Study	Source	Focus	Themes and patterns	Synthesis
31	Tuong & Dan (2024)	Journal article	Listening comprehension in EFL	Engaging features aid listening; further feedback improvements suggested.	A solid tool for immersive listening practice with room to evolve.
32	Habibie (2020)	Journal article	EFL motivation enhancement	Effective in spurring beginner engagement; vocabulary gaps noted.	Motivates learners, but needs richer content for advanced proficiency.
33	Shortt et al. (2023)	Journal article	Systematic review of gamification	Reviews trends in gamification; design elements are key.	Gamification is central to engaging language learning, pending deeper outcome research.
34	Sadaf (2023)	Journal article	Impact of Duolingo English Test	Enhances proficiency tracking but calls for greater awareness/training.	Benefits evident—wider training can amplify its academic impact.
35	Peláez-Sánchez & Velásquez-Durán (2023)	Journal article	Linguistic competence in virtual courses	Improves phonological and orthographic control in English.	A powerful m-learning tool for bolstering virtual language competence.
36	Ilyas et al. (2023)	Journal article	University vocabulary enhancement	Statistically significant vocabulary gains via structured practice.	Strong support for integrating Duolingo into vocabulary curricula.
37	Tahir & Tafat (2023)	Master's dissertation	EFL attitudes toward vocabulary learning	Positive acceptance linked to ease, flexibility, and utility.	Overall, a motivating, user-friendly tool despite minor technical issues.
38	Sari, Hadina & Yoni (2023)	Journal article	Student perceptions in English learning	Interactive features boost engagement and language skill growth.	Duolingo is a potent supplement that enriches traditional learning.
39	Chasanah & Halim (2024)	Journal article	Interactive learning media for language	Experimental evidence of gains in vocabulary and speaking.	Reinforces Duolingo as an effective add-on for language instruction.
40	Rouabhia & Kheder (2024)	Journal article	Vocabulary learning: Systematic review	Gamified design and individualized feedback are critical drivers.	Conclusively positive for vocabulary, warranting further integrative research.