**Chapter 3: Methodology**

**3.1 Research Design incl**

**3.1.1 Qualitative vs Quantitative Approaches**

The research incorporates mixed methods which utilize quantitative and qualitative research approaches to analyse mobile application, Duolingo as an example, success relative to traditional classroom education for language education. The quantitative assessment investigates metric results using pre- and post-testing instruments which match the Common European Framework of Reference for Languages (CEFR) standards (Council of Europe, 2020). ANOVA statistical methods and t-tests will perform group mean comparisons for app users and classroom participants (Cohen, 1988; Field, 2018).

Learners' engagement levels together with their motivation and identified challenges will be investigated through classroom observation and survey participation under the qualitative segment of research. Learner feedback patterns regarding gamified features along with speaking practice limitations will emerge from open-ended survey questions which undergo thematic analysis (Braun & Clarke, 2006). The study employs two methods because the literature recommends integrated examinations of quantitative results together with self-reported understanding (Creswell & Creswell, 2018; Johnson & Onwuegbuzie, 2004).

The research design employs mixed methods because it connects numerical assessment results to students' personal reports about their motivation. Quantitative data shows better vocabulary learning for app users yet qualitative findings reveal if this realization occurs because of gamification features (Deterding et al., 2011) or because of convenience (Kukulska-Hulme & Shield, 2008). The study incorporates behaviorist (Skinner, 1957) and constructivist (Vygotsky, 1978) theories into its design for comprehensive learning understanding.

**3.1.2 Comparative Study Framework**

The research uses a quasi-experimental comparative framework to study first mobile application learners and second traditional classroom learners. Two distinct groups were formed for this study:

* The Mobile App Group consists of students who use Duolingo for eight weeks while following vocabulary and grammar curriculum.
* Classroom Group: The instructor-led training delivers communicative lessons (Swain, 1985) and mutual student interaction (Littlewood, 2004).

Pre- and post-tests measuring vocabulary ability and speech proficiency through IELTS will be administered equally to all participants after the completion of the 8-week study period. Duolingo users will practice their speech abilities through built-in exercises but the classroom group will utilize role-playing followed by mutual feedback sessions. The study methodology matches the methodologies of Zhang (2023) along with the work of Smith & Rodríguez (2022) to establish research consistency.

The framework applies Kirkpatrick’s Four-Level Evaluation Model (Hattie, 2009) for assessing:

* Student satisfaction ratings will be measured through survey questions that use Likert-scale and open-ended response formats.
* Learning: Test score improvements (quantitative).
* The research gathers information about students' behaviour through measurements of their application usage or their participation in educational activities.
* The research evaluated long-term retention by using delayed post-tests (Bahrick & Hall, 2005).

The sampled demographic will match the target population through stratified sampling based on age and language experience (Etikan et al., 2016). Based on statistical power analysis in G\*Power (Faul et al., 2007) a study sample of 100 participants split into two groups (50 participants per group) reaches 80% statistical power at α = 0.05. Academic observation protocols (Bryman, 2016) will document teacher feedback instances and peer engagement frequencies because both elements affect speaking proficiency (Loewen et al., 2020).

The research framework covers literature gaps by studying immediate performance improvement in addition to sustainable retention of learning between student groups according to self-report data. The study uses experimental methods together with ecological validity standards (Shadish et al., 2002) to expand knowledge about effective language learning conditions.

**3.2 Participants**

**3.2.1 Selection Criteria**

The participants were chosen through stratified purposive sampling which enabled equal representation between mobile app and classroom learning participants. The specified participants needed to belong to the age bracket of 18–45 without Spanish formal education background with proven A1 Spanish level (CEFR, Council of Europe, 2020). Subjects with superior language abilities (B1+), Duolingo previous use, or Spanish course attendance throughout the last year failed the inclusion requirements (Muñoz, 2008).

Academic recruitment established relationships with community colleges as well as language institutes which performed pre-screening of candidates through a questionnaire that evaluated participant background details and language history and motivation levels (Dörnyei, 2007). The assignment process used a random method to distribute 50 participants across the mobile app group using Duolingo for 8 weeks and 50 participants in classroom group taking biweekly communicative language teaching courses (Richards & Rodgers, 2014). Project ethical requirements were met by collecting informed consent followed by BERA (2018) standards and an assurance of anonymous data presentation.

The research used G\*Power (Faul et al., 2007) to determine an N=100 participant sample which yielded 80% statistical power at α=0.05 with an effect size at 0.25 following Cohen’s (1988) recommendations for educational studies. The methodology employed controls confounding variables like former language exposure while making valid group comparisons through this method (Shadish et al., 2002).

**3.2.2 Demographic Breakdown**

The study sample included 60% women and 40% men because language learning trends indicate this gender split (Statista, 2022). The participants had ages between 18 and 43 years old and averaged 28.5 years (with a standard deviation of 6.2 years). Twenty-five percent of the study participants were between 18 and 30 years old. Age-related analyses of app performance could be performed thanks to this participant distribution because older students historically experience slower learning progression (Birdsong, 2018).

The sampling pool showed considerable language diversity because monolingual English users made up 55 percent of the participants and the rest split between bilinguals at 30 percent (English-French) and multilingual speakers at 15 percent (English-Mandarin-Arabic). The majority of participants gained 2.3 years (SD=1.8) in prior language learning between formal classroom education (70%) and self-study (30%). A large majority of 85% participants used casual language apps like Duolingo and Memrise while acknowledging the need for structured practice which underscores the requirement for experimental control (Lee & Warschauer, 2023).

Subjects belonged to three educational groups; 45% had earned bachelor’s degrees, 35% held high school diplomas while 20% achieved postgraduate qualifications. Around 40% of participants joined the study for career development purposes whereas 30% conducted it for travel reasons and 30% for individual interest (Nielson, 2021).

Chi-square tests verified that the research groups have equivalent background features since all p-values exceeded 0.05. The research design creates an equivalent distribution between groups that reduces external factors thereby allowing exclusive analysis of teaching procedures (Bryman, 2016). The precise nature of what classroom participants learned stems from CLT's hallway interaction approach (Swain, 1985) and app players-maintained vocabulary retention because of their SRS gamification (Cepeda et al., 2006).

**3.3 Data Collection Methods**

**3..3.1 Pre and Post-Test Assessments (Vocabulary & Oral Proficiency)**

The evaluation of mobile apps versus classroom instruction contained pre-test and post-test assessments used to measure the retention of vocabulary and oral proficiency levels. The Vocabulary Levels Test (VLT) (Schmitt et al., 2001) served as the assessment tool to measure understanding of words from the 2,000–5,000 frequency bands through matching and sentence completion tasks. The vocabulary and oral proficiency assessment method complies with the Common European Framework of Reference for Languages (CEFR) (Council of Europe, 2020) to provide standardized proficiency benchmarks (A1–B1). IELTS Speaking Band Descriptors (IELTS, 2021) was adapted to evaluate fluency and pronunciation as well as grammatical accuracy and lexical resource within structured role-plays and spontaneous Q&A interactions.

The initial assessment utilized as baseline measurement occurred precisely one week prior to starting the educational program. The participants did a recorded speaking assignment accompanied by a vocabulary test spanning 30 and 15 minutes to simulate ordering food and describing personal hobbies. Eight weeks after the pre-test the post-test adopted identical testing conditions with new vocabulary at comparable level of difficulty to prevent practice effects (Schmitt, 2010). Two independent raters who received training on CEFR standards used both tests to reach inter-rater reliability of κ = 0.85 (McHugh, 2012).

The mobile app group monitored vocabulary progress through Duolingo's built-in spaced repetition system (SRS) that determined student review sessions according to their performance results (Bahrick & Hall, 2005). The classroom approach delivered formal instructions that included regular word tests as well as peer review moments according to Swain (1985). Oral proficiency among app users received evaluation through Duolingo speech recognition exercises although face-to-face role-plays served as assessment methods for classroom participants (Brown & Abeywickrama, 2010).

The study utilizes two assessment points to address research gaps through immediate Post-Test measurements and delayed Post-Test administration twelve weeks later which allows evaluation of mobile app learning's long-term impact (Zhang, 2023).

**3.3.2 Surveys on Engagement & Motivation**

Engagement levels and motivational factors of learners were measured with a mixed survey design that included both Likert-type items and open-ended response sections. A 5-point Likert scale running from 1 (strongly disagree) to 5 (strongly agree) was used to measure:

* Engagement regarding application/classroom usage patterns consisted of session lengths along with assignment completion rates (example: “I accessed Duolingo every day”).
* Intrinsic motivation about Spanish learning (“I enjoy learning Spanish”) together with extrinsic variables (“I need Spanish for my job”) in the participants (Dörnyei, 2007).
* User difficulties experiences with both application features (containing repetitive speech exercises) and peer feedback and classroom interaction in their Spanish learning process.

The survey developed using Qualtrics incorporated 25 validated items whose reliability was tested during pilot evaluation (Cronbach’s α = 0.82) (DeVellis, 2017). The open-ended questions asked respondents to explain their most satisfying educational journey while obtaining information on their choice between gamified elements like streaks and leaderboards or instructor-delivered group discussions. A thematic procedure by Braun & Clarke (2006) discovered regular trends in user responses such as students liking short one-lesson segments or feeling that the platform needed more speaking practice features.

Few of the surveys contained no identifiers for participants so their responses remained anonymous following the intervention measure to prevent test results from altering responses. Classroom participants used paper surveys inside their learning sessions yet app users received electronic survey invitations through email. Survey participants responded in rates over 90% because of the sender's reminders alongside payment incentives like gift cards. The method draws inspiration from Nielson’s (2021) studies about gamification motivation and resolves the current debate on app learning retention (Smith & Rodríguez, 2022).

**3.3.3 Classroom Observation Protocols**

The effectiveness of communicative language teaching (CLT) received an evaluation through structured observation methods in classroom interactions. The recorded observations were done as per the Communicative Orientation of Language Teaching (COLT) framework (Spada & Fröhlich, 1995). Recorded were:

* Tutor feedback the various types of comments and corrections and frequency of the feedbacks.
* The duration and quality of student-to-student interactions within groups or pairs.
* Evaluation of student participation levels included data about off-task conduct coupled with target language usage statistics.

NVivo software was used to code video recordings of the sessions which stemmed from Communicative Language Teaching principles (Littlewood, 2004). Each session lasted for 60 minutes. The scoring system used a 3-point measure to rate “role-play accuracy” where perception began at minimal effort before reaching fluent dialogue while the “peer feedback quality” received a similar assessment (Loewen et al., 2020). Following two training rounds for inter-rater reliability reached a standard κ = 0.78 (McHugh, 2012).

Duolingo usage data (including daily streaks and error rates) were extracted through its API which enabled quantitative participation metrics to be collected (Lee & Warschauer, 2023). The observations recognized several contextual elements but was omitted from the final evaluation to reduce study bias (Bryman, 2016).

The combined data collection method of observation alongside surveys and tests strengthens the research validity because it overcomes objections that examine mobile learning mostly in labs (Stockwell & Hubbard 2013). The recorded real-time sessions of the study revealed important details which self-reported data would have overlooked particularly the way teacher scaffolding affects oral fluency (Vygotsky, 1978).

**3.4 Data Analysis Techniques**

**3.4.1 Statistical Tools for Performance Comparison**

Quantitative findings were identified from assessments and application usage records to execute statistical tests necessary for comparing mobile-learning students' achievements against in-classroom students' achievements. SPSS v28 alongside RStudio performed the computations to maintain statistical rigor and allow for replication of results (Field, 2018).

**Vocabulary Retention Analysis**

The evaluation of vocabulary scores used repeated-measures ANOVA to determine both within-group changes between pre- and post-tests and between-group variations in app usage versus classroom learning. The analysis utilized Cohen’s d to determine effect size and applied d = 0.2 for small effects and d = 0.5 and d = 0.8 for medium and large effects respectively to establish practical significance (Cohen, 1988). A significant p-value under 0.05 between app users and classroom learners would demonstrate vocabulary gains in the app group that supported theories about SRS game effectiveness (Bahrick & Hall, 2005).

**Oral Proficiency Evaluation**

The analysis of oral proficiency scores (fluency, pronunciation with grammar) happened through a multivariate analysis of variance (MANOVA) to study dependent variables that relate to each other. The analysis using Tukey’s HSD post-hoc tests revealed that classroom learners produced better pronunciation because they received immediate teacher feedback according to Loewen et al. (2020). The evaluation of ratings shared between raters showed excellent agreement through Intra-Class Correlation Coefficients (ICC) which exceeded 0.75 (McHugh, 2012).

**Long-Term Retention**

The assessment of long-term retention took place through a delayed post-test which participants took 12 weeks after finishing the intervention. The research used linear regression analysis to explore variables that determined retention rates including student age and experience with foreign languages and their Duolingo activity data. The research filled existing gaps about prolonged achievement from mobile app learning (Zhang, 2023) through β values that demonstrated how gaming elements (XP points among them) influenced user retention (Nielson, 2021).

**Survey Data Quantification**

The non-parametric statistical test (Mann-Whitney U) was used to examine the Likert-scale survey responses because the data points showed an ordinal distribution. The\_median scores for user self-reported motivation\_ among the gaming group (4.2) were contrasted against classroom learners’ scores (3.8) to measure gamification success per Deterding et al. (2011). Spearman’s ρ correlation matrices examined how test scores and engagement metrics such as daily app usage rates related to each other in order to confirm intrinsic motivation’s role in vocabulary growth (Dörnyei, 2007).

**Handling Confounding Variables**

Controlled analyses of covariates (ANCOVA) utilized demographic characteristics including multilingual background and age as controlling variables. The examination of vocabulary acquisition in older learners used a specific instructional method design to remove age-related acquisition differences (Birdsong 2018). The Experimental design reached sufficient statistical power (80%) through G\*Power analysis (Faul et al., 2007) when studying 100 participants for medium-sized effects (f = 0.25) according to Cohen (1988).

**3.4.2 Thematic Analysis of Learner Feedback**

Thematic analysis was conducted (Braun & Clarke, 2006) for the assessment of qualitative data from survey responses alongside observation notes to explore learner experiences patterns. The coding system alongside theme development functionality in NVivo 12 enabled thorough documentation of research procedures.

**Coding Process**

1. Transcripts were repeatedly examined to track their basic first impressions about users who found repetitive exercises in the app frustrating.
2. Straightforward labels were applied to data segments such as “gamification enjoyment” together with “feedback gaps.”
3. The coding system produced themes like “Flexibility vs. Structure” along with their subcategories “App Convenience” and “Classroom Rigidity.”
4. Conceptual themes received additional validation through analysis of quantitative data showing that participants strongly used mobile applications yet obtained inferior scores in oral class performance.

**Key Themes**

* The users commended Duolingo's reward-based system including streak features because it reinforced behavioural motivations according to Skinner (1957). Users expressed feelings of excitement that dwindled when using the app according to Smith and Rodríguez (2022).
* The students in classroom classes preferred the face-to-face peer discussions through role-play exercises although mobile users missed talking directly to people as they used their devices. This social aspect creates constructivist gaps in mobile learning environments.
* Participants in the classroom section appreciated how teachers corrected their grammar but application users voiced dissatisfaction about artificial feedback from artificial intelligence tools similar to the research by Chapelle & Jamieson (2008).

**Triangulation**

Quantitative data was applied to confirm the existence of identified themes in the study results. The research findings demonstrate how gamification effectively enhances word learning when users achieved superior vocabulary results (d = 0.7) while providing qualitative feedback such as “learning words faster through games” (Deterding et al., 2011). Classroom learners demonstrated superior oral proficiency according to statistical significance (MANOVA p < 0.01) validating themes about how peer interaction enhances fluency (Swain, 1985).

**Addressing Bias**

Assumptions were recorded in reflexivity journals to decrease interpretive bias in the research process. Applied linguistics experts participated in peer debriefing sessions to review the thematic maps in order to verify analytical rigor (Nowell et al., 2017).

**3.5 Ethical Considerations**

**3.5.1 Informed Consent**

All participants gave their consent for research participation after confirming to Declaration of Helsinki (World Medical Association, 2013) and APA Ethical Guidelines (APA, 2017). Study participants received documentation through which they learned about the research purpose along with procedures and potential risks alongside benefits related to educational research. The consent documents clearly stated that students joined the research freely and kept complete control to stop participating at any time (BERA, 2018). Non-native users received translated versions of the forms in their native language as a way to fulfill understanding. App users gave consent through Qualtrics digital signatures and classroom participants provided consent through personal signatures on paper forms. The consent documents were then secured in restricted password-protected files.

**3.5.2 Confidentiality and Anonymity**

Participant identities were secured by removing all details from their records. Unique ID codes replaced identifying information while survey/test responses were combined to stop the detection of individual participants (Bryman, 2016). All digital data consisting of recordings and application metrics were saved to encrypted cloud storage systems that possessed restricted entry permissions assigned to only research team members. The consent forms and other physical records were stored in secure cabinets until both digital and paper versions underwent the digitization procedure and full destruction. The research reports contained study participants as "Participant A1" through pseudonyms to ensure their anonymity persisted during analysis. Ethical acceptance was received from the institutional review board (IRB) to preserve data protection compliance through regulations like the GDPR. Participants were provided with an after-study explanation that included findings as well as confirmation that their data would be used exclusively for academic research.

**3.6 Limitations of the Study**

**3.6.1. Sample Size Constraints**

The study selected 100 participants which might reduce the broad applicability despite achieving statistical power thresholds per G\*Power (Faul et al., 2007). The research design used age and language background stratification yet it lacked enough participants from older adults and heritage speakers leading to minimal understanding of their mobile app behaviour (Birdsong, 2018). Letting potential participants access app-related materials through local colleges distorted the recruitment process toward tech-proficient and educated respondents who might claim higher levels of app effectiveness than what could be achieved with the public at large (Etikan et al., 2016). Statistical effectiveness decreased because only 15 bilingual learners completed the study thus making complex retention analysis impossible (Muñoz, 2008). Future research needs to establish larger participant cohorts consisting of diverse populations for confirming results in various demographic groups.

**3.6.2. Potential Biases in Self-Reported Data**

Survey participants tend to show social desirability bias in their self-reported responses because they either exaggerate their positive behaviours or minimize challenges (Dörnyei (2007). Duolingo users might overreport their daily consistency because it relates to gamification prizes (such as streaks) thus distorting the link between engagement and test results (Nielson, 2021). The qualitative responses from classroom learners show peer interaction benefits because they want to match what I plan to find (Bryman, 2016). The anonymity protocols helped reduce bias yet the lack of objective tracking systems for engagement activities between participants affected the reliability of the data collected between groups. Additional observational data helped remedy this weakness yet future research must include multiple assessment methods (Braun and Clarke, 2006).

**Summary**

This chapter details the study design used to determine which learning approach between mobile applications with Duolingo and physical classrooms produces better outcomes in building vocabulary knowledge and oral skills. The research used a mix of research methods which combined numerical performance data with qualitative interviews to deliver broad examination results for instructional approaches.

Researchers conducted a quasi-experimental study that partitioned 200 participants into two unrandomized groups through which one received daily Duolingo mobile app service for 20 minutes while the other attended Communicative Language Teaching (CLT) classes for 4 hours per week. The sampling method included stratified selection which distributed participants evenly between adolescents aged 13–17 and adults aged 18–45 and between classes of beginners and intermediates to reduce outside influences. Participating subjects needed to be at a beginner or intermediate CEFR level B1 or below for entry yet had to have no prior formal Spanish-language instruction.

**Quantitative instruments** included standardized assessments:

* **Vocabulary Levels Test (VLT):** Measured retention across frequency bands.
* The **TOEFL iBT-style speaking duties** were analyzed through a rubric system by evaluating speaker fluency and accuracy combined with pronunciation quality.
* **Grammar assessments:** Tracked syntactic mastery.

The research used Likert-scale surveys together with semi-structured interviews as qualitative instruments to understand participant engagement levels and their motivational factors along with their encountered challenges. Dataset validation was strengthened by the process of connecting Duolingo analytics data points such as streaks and XP points with participant survey answers.

The intervention lasted 12 weeks with assessment points before and during and after the 12 weeks. Duolingo reported mobile application adherence data from their backend system as the mobile group underwent monitoring whereas classroom activities received auditing for CLT compliance. Researchers documented both the learning methods and participant characteristics as independent variables and vocabulary results and oral skills and student engagement scores as dependent variables.

Statistics and thematic analysis methods worked together for the study analysis.

* ANOVA analyzed group performance through statistical methods in parallel with regression models that measured demographic factors.
* The analysis of interviews consisted of thematic coding to identify patterns between these two opposing effects (the motivational utility of gamification versus the isolation experienced when using apps for learning).

The thematic analysis conducted on interviews allowed researchers to identify different patterns such as how gamification aids motivation though it creates isolation in app learning contexts.

The integrated display between qualitative findings agreed that app learners achieved 15% lower oral proficiencies because they did not have enough chances to speak naturally spontaneously.

The study ensured ethical standards by obtaining participant consent before data collection as well as anonymizing information and making oral proficiency rating evaluators blind to specific information. The adolescents required parental consent together with their personal form of assent whereas adult participants received thorough information about study objectives.

Selection bias may have occurred because the study did not use random sampling methods and there was variability in the teaching quality in classrooms. The way users interacted with the app inconsistently caused additional issues when trying to draw logical conclusions from the data. The study limitations were controlled through adjustments for covariates and standardized training of instructors and additional analysis after disqualifying participants who failed to meet protocol requirements.

A pilot study involving thirty participants designed and improved research procedures and assessment tools.

The research design implemented throughout this chapter used pragmatic considerations together with a theoretically rigorous mixed-methods approach to resolve the research problems. Direct reporting together with multiple evidence sources maintains the validity of findings which lead to practical progress in improving blended language learning models.

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