v1: 25 July 2024

Research Article

Analyzing the Effects of Mobile Assisted Language Learning on Learner Autonomy: A Quasi-Experimental Study

Peer-approved: 25 July 2024

© The Author(s) 2024. This is an Open Access article under the CC BY 4.0 license.

Qeios, Vol. 6 (2024)
ISSN: 2632-3834

Felix Estrella[1]

1. Escuela Superior Politécnica del Litoral, Ecuador

The advent of mobile technology has led to a significant shift in language learning, with an increasing number of learners now using mobile devices to enhance their learning experience. However, little is known about the impact of mobile-assisted language learning (MALL) on learner autonomy, a key indicator of successful language learning in the Ecuadorian context. This study aims to bridge this gap. A mixed-methods quasi-experimental research design was chosen to achieve this aim. A survey and semi-structured interviews were the chosen data collection tools. Ninety Ecuadorian undergraduate polytechnic students, divided equally into control and experimental groups, participated in this investigation. The quantitative results were not statistically significant in identifying a positive change in learner autonomy after the intervention. Nonetheless, learners admitted having had a change in their autonomy levels during the interviews.

Correspondence: papers@team.qeios.com — Qeios will forward to the authors

1. Introduction

1.1. Background of the study

At its core, learner autonomy is the ability to take control of the learning process, make informed decisions, establish objectives, and organize learning activities without the teacher being a constant observer (Borg & Alshumaimeri, 2017). In educational settings, learner autonomy relates to students' active engagement (Alsharari & Alshurideh, 2021), independence (Shen et al., 2020), and responsibility in acquiring knowledge (Godwin-Jones, 2019), skills (Zainuddin & Perera, 2017), and grasping the subject matter (Little, 2020). Learner autonomy consists of interrelated critical components in developing self-directed and empowered learners.

The first component is self-regulation, which enables learners to assess their learning experience, influencing their belief in their ability to do specific tasks well (Duchatelet & Donche, 2019). As a result, they can organize, monitor, and control their learning. The second element is decision-making, which is critical in shaping and fostering learner autonomy (Ozer & Yukselir, 2021). It empowers students to make informed choices in approaching their learning. It gives students control over their educational pursuits by cultivating critical thinking and adaptability to self-regulate and manage their learning experiences (Royce et al., 2019; Arvanitis & Krystalli, 2021). The last two factors are motivation and engagement, which are catalysts to cultivate learner autonomy. Motivation, which can be intrinsic or extrinsic, serves as an impulse that drives students toward their academic objectives (Puspitarini & Hanif, 2019). With strong intrinsic motivation, students tend to exhibit higher levels of engagement and autonomy. According to Vohra & Bhardwaj (2017), engagement reinforces learner autonomy through active participation, profound interest, and excitement in learning activities. Engaged learners are likelier to take the initiative, explore varied learning possibilities, and actively seek information outside the prescribed curriculum, boosting their self-directedness and decision-making abilities (Sari, 2020).

1.2. Statement of the problem

Incorporating technology into language learning has seen a paradigm shift in modern educational environments, notably with the emergence of mobile-assisted language learning (MALL) applications. While the potential benefits of MALL in improving language learning have been well

 doi.org/10.32388/GARTGH.2

recognized, its specific influence on encouraging learner autonomy remains an area that requires further exploration.

This paper aims to address the gap by conducting a quasi-experimental study to examine the effects of MALL on learner autonomy in an English as a foreign language environment. It seeks to investigate methods to encourage student autonomy by utilizing accessible technology for learners and teachers in various learning situations, such as computers and the Internet. It focuses on students' perceptions of the impacts of implementing MALL in their English class and the pros and cons of deploying technology.

1.3. Research questions

RQ1: To what extent does implementing MALL in the English as a foreign language class affect the self-perceived autonomy levels of undergraduate Ecuadorian polytechnic students?

RQ2: How do undergraduate Ecuadorian polytechnic students perceive the use of MALL?

RQ3: What are the benefits and challenges of using MALL in the English as a foreign language class as perceived by undergraduate Ecuadorian polytechnic students?

2. Literature review

2.1. Mobile Assisted Language Learning

For Shortt et al. (2021), mobile-assisted language learning is a form of learning mediated using mobile devices, allowing learners not to be anchored to a specific geographical location. Meanwhile, Hoi (2020) ascertains that MALL refers to using mobile devices such as phones, tablets, or other technology to ease and support language learning processes. Moreover, mobile devices permit teachers to innovate and access resources anywhere and anytime, learning in places other than a classroom (Arvanitis & Krystalli, 2021). Wireless communication technologies play a crucial role without which MALL would not exist (Talan, 2020).

MALL is a transformative pathway in language education, easing technology integration into the learning process (Terzioğlu & Kurt, 2022). MALL represents the fusion of mobile devices and language-learning tools, providing a dynamic platform for immersive, adaptable, and personalized learning experiences (García Botero et al., 2019).

Fundamentally, MALL represents the convergence of mobile devices and technologies for language learning, providing an active environment for individualized, immersive, and adaptable learning (Andujar et al., 2020). This integration represents a paradigm change in pedagogy that redefines the fundamentals of language learning, going beyond simple resource availability. Learners get access to an extensive array of interactive activities, multimedia information, language learning tools, and communication platforms via mobile devices (Klimova, 2019). This collection of resources encourages participation, interaction, and adaptability in the educational process.

The flexibility of MALL to adapt to various learning environments is essential to its integration (Viberg et al., 2020). Language learners are not limited to the walls of traditional classrooms; they can interact with language materials at any time, any place (Arvanitis & Krystalli, 2021). The portability of mobile devices guarantees a continuous learning experience by facilitating learners' smooth transitions between formal and casual learning venues (Jeong, 2022). To encourage a more comprehensive and ongoing approach to language acquisition, learners can use mobile platforms to participate in conversational language exercises or use language apps to practice vocabulary while commuting.

Moreover, MALL's approach envelops diverse learning styles and preferences within language learning (Alhadiah, 2020). The possibility to integrate several multimedia elements and interactive tools is decisive in personalizing a class to different learning modalities. For example, Kohler & Dietrich (2021) explain that videos, infographics, and visual vocabulary aids used by the available language learning apps benefit visual learners. Meanwhile, auditory learners engage with audio materials like podcasts, pronunciation guides, and language drills, enhancing their listening and oral proficiency (Albar & Sari, 2020). Kinesthetic learners find interactive exercises, role-playing scenarios, and gamified language activities conducive to their hands-on learning style, promoting active participation and skill application (Pazilah et al., 2019).

Additionally, MALL's inherent customization features enable students to tailor their educational experiences (Alhadiah, 2020). Students can select language learning applications or platforms based on their language objectives and cultural preferences (García Botero et al., 2019). This autonomy guarantees that students stay interested and involved, encouraging a positive attitude toward language learning (Alsharari & Alshurideh, 2021). In addition, adjusting learning activities to each student's preferences maximizes language skill growth potential by improving the overall efficacy of the learning process (Mohammad & Masoumi, 2021).

By providing resources for self-directed learning, MALL's integration promotes learner autonomy (Okumuş Dağdeler, 2018). To fit their unique requirements and learning styles, students can select from a wide range of resources, track their progress, and define individualized learning goals (Peng et al., 2020). In addition to creating a sense of control over the learning process, empowerment also develops intrinsic motivation (Hsu & Lin, 2021), encouraging a more profound and longer-lasting engagement with language learning (Miqawati, 2020). Therefore, MALL's integration goes beyond being a simple technological add-on; instead, it is a driving force behind the transformation of language learning, providing a flexible and adaptable framework that empowers learners in their linguistic journey.

2.2. The evolution of mobile technology in education

The integration of mobile technology into education started with handheld devices in the late 1900s (Bernacki et al., 2020). However, these devices were limited in functionality (Morikawa et al., 2021). They offered portability and basic tools that educators began including in their teachings. A significant change was brought about by the widespread use of smartphones and tablets in the late 2000s. According to Sophonhiranrak (2021), these devices were widely used in education because of their many features, which included internet connectivity, multimedia functions, and app ecosystems. Programs such as One Laptop Per Child attempted to democratize access to education by bridging the digital divide and giving low-income communities worldwide access to inexpensive gadgets (Selwyn, 2023).

Mobile technology has completely changed how we teach and learn by enabling individualized, dynamic, and adaptable educational experiences (Bernacki et al., 2020). Teachers could produce interesting content, present classes, and grade students from a distance, thanks to learning management systems (LMS) and educational apps (Turnbull et al., 2020). Platforms like Google Classroom made communication, assignment submission, and grading procedures easier. Edmodo, and Canvas (Syakur et al., 2020). Additionally, mobile devices made a variety of learning modes accessible. To accommodate different learning styles and boost student engagement, they allowed the distribution of multimedia-rich knowledge through interactive simulations, gamified learning experiences, and other means (Yuan & Wu, 2020).

These days, according to Al-Emran et al. (2019), mobile technology is still developing and giving cutting-edge capabilities like Internet of Things (IoT) integration, machine learning (ML), and artificial intelligence (AI). AI-driven adaptive learning systems, such as Coursera and Khan Academy, tailor learning paths to meet the needs of specific students (Ngo et al., 2023). Improved AI-driven tailored learning, more AR/VR applications, wearable device integration for real-time feedback, and 5G technology utilization for better connectivity and teamwork are potential future developments in mobile technology.

2.3. Challenges in MALL integration

One of the challenges widely reported in the literature related to technology is the limited access to mobile devices (Abidin et al., 2017; Williams et al., 2018; Olaleye et al., 2019; Patel & Shortliffe, 2023). Not every student has a mobile device; sometimes, there are not enough mobiles in a classroom. This can make it hard for teachers who want to incorporate MALL in their classes. Moreover, it can create unequal learning opportunities (Lim et al., 2021). Another technology-related challenge teachers who wish to implement MALL in their classrooms must face is the unreliability of their and learners' Internet connectivity (Nuraeni et al., 2020). This issue, explain the authors, may prevent learners from accessing resources and completing tasks requiring Internet access.

There are several pedagogical challenges to consider when integrating MALL in EFL classrooms. According to Solihin (2021), it might be difficult for some teachers to adapt their lessons and teaching methods to incorporate MALL effectively. Traditional activities need modifications to accommodate the use of mobile devices, which can be time-consuming and require additional preparation (Ghorbani & Ebadi, 2020). Moreover, teachers must be adequately trained and equipped to use MALL effectively, so they must get involved in professional development.

Student engagement is a significant difficulty when introducing MALL in a classroom. Learners, explains Dashtestani (2015), may lack the motivation to use their mobile phones for language learning. This indifference can affect their class participation and overall achievement. While students use their mobile devices for language learning, they might get distracted by watching videos, playing online games, or using social networks for purposes other than language learning (Alrefaai, 2019). Thus, these distractions interfere with the learning process, reducing the effectiveness of MALL activities.

2.4. Previous studies

Hazaea and Alzubi (2018) examined how mobile technology helped 30 Saudi Arabian students. The researchers designed a qualitative action research study with a preparatory year reading class. Participants used WhatsApp to communicate with teachers and peers outside the classroom and access reading materials. The investigators used students' portfolios and semi-structured interviews to collect data. They concluded that participants developed a sense of learner autonomy related to their use of WhatsApp, which led to a more focused learning atmosphere, saving time and effort during traditional classes.

Falah Alzubi (2019) conducted research in Saudi Arabia utilizing a qualitative experimental design to investigate the impact of smartphone-mediated language learning strategies on learner autonomy. The study recruited 35 pre-university students who participated in a semi-structured interview. The researcher reported that participants used memory, social, and cognitive strategies to improve their reading skills. Students could enhance their autonomous learning skills after using their mobile phones to mediate their reading skills.

Another study conducted in Indonesia by Adara (2020) aimed to analyze the effects of MALL on learners' autonomy and motivation. The researcher set up an experimental group taught using MALL-integrated lessons and a control group given traditional sessions. The scholar used questionnaires and semi-structured interviews to collect data. Results suggest that MALL negatively impacted learners' autonomy and motivation. Nonetheless, it is disputable that the results obtained by this study can be generalized, as the researcher used a reduced sample of 35 students.

Fakih (2022) used a quasi-experimental research design that employed pre- and post-tests to evaluate the effectiveness of

a vocabulary-based intervention using SMS. Eighty undergraduate students were recruited from two Saudi universities. The researcher used a 22-hour intervention, a questionnaire, and semi-structured interviews to obtain participants' perceptions of using SMS to learn vocabulary words and their contribution to their learning autonomy. Results reported vocabulary acquisition and satisfaction in learning autonomy.

Akman and Karahan (2023) conducted a mixed-methods research study in which 110 students participated. An online questionnaire and written interviews were used as data collection tools. The researchers used SPSS to analyze the survey and content analysis for the interview results. The investigators suggested that students expressed positive opinions about using mobile apps for language learning. Nonetheless, there were statistically no significant differences in learner autonomy and motivation perceptions between the experimental and control groups.

2. Methods

This study employs a mixed-method quasi-experimental design. In this design, participants were assigned to an experimental group that received the MALL intervention and a control group that was taught traditionally (Gopalan et al., 2020). The researcher follows Creswell's (2018) suggestion to evaluate both groups before and after the intervention.

The participants in this study were selected using convenience sampling, a non-probability sampling technique that involves selecting participants who are readily available and willing to participate (Stratton, 2021). All participants are English as a Foreign Language (EFL) students at a public tertiary institution in Ecuador. They are taking the last subject of English and are registered in the courses assigned to the researcher. Table 1 contains the complete demographic data of the study participants.

Demographics	Categories	N=126	%
Gender	Male	77	61
	Female	49	39
Age	20-22	91	72.2%
	23-25	28	22.2%
	26 and up	7	5.6%
City of origin	Guayaquil	91	72.2%
	Duran	21	16.6%
	Santa Elena	14	11.1%
Faculty	FIEC	21	16.6%
	FCSH	28	22.2%
	FIMCP	21	16.6%
	Other engineering programs	56	44.4%

Table 1. Participants' demographic data

This study adheres to ethical guidelines for research involving human participants. Informed consent was obtained from all participants before their involvement in the study. Participants were told that confidentiality and privacy would be protected throughout the study, and their data would be anonymized and stored securely. Any potentially harmful or distressing effects of the study would be minimized, and participants were informed that they would be free to withdraw from the study at any time.

The data collection tools involved a survey and semi-structured interviews. The survey was administered to both groups before and after the intervention to measure changes in students' perceptions of learner autonomy. The survey was adapted from Gholami (2016) and consisted of two sections—the first section aimed to obtain students' demographic information. The second section asked students for their perceptions of learning autonomy. It contained 32 5-point Likert scale statements where one equals completely disagree, and five equals completely agree. The survey was piloted with fewer participants, and Cronbach's alpha was calculated at 0.875, which according to Taber (2017) is a robust coefficient.

Semi-structured interviews were selected to allow for more elaborate, descriptive responses from participants while still adhering to a basic line of inquiry around key topics of interest. They were conducted after the intervention had concluded with twelve respondents following the suggestions of several other researchers (Saunders & Townsend, 2016; Morrow et al., 2022; Newington et al., 2022). A six-question protocol was created in consultation with three experts in education to support content validity (Usry et al., 2017). Member checking occurred during the interviews to validate interpretations of responses in real time (Candela, 2019). Interviews were recorded and transcribed verbatim. Twenty percent of transcripts, selected randomly, were cross-checked between two researchers to substantiate consistency.

The intervention, which lasted for four weeks, consisted of introducing several online tools that participants of the experimental group had to use during their out-of-class study time. These tools were related to different language components introduced in the face-to-face classes. Homework was assigned, and students had to use the tool introduced in a specific week. The main role of the teacher-researcher was to conduct the weekly classes in which the tools were introduced, assign the weekly tasks, monitor learner activity, and provide learners with guidance in the learning process.

3. Analysis

Both quantitative and qualitative data were gathered and examined for the current investigation. The statistical software SPSS, version 20, was used to analyze the quantitative data gathered using pre- and post-questionnaires. The Shapiro-Wilk normality test was used to analyze the data and determine if they had a normal distribution. Subsequently, descriptive analyses were conducted, and mean scores and standard deviations for every group in the second section of the survey were computed. Independent-sample t-tests were employed to compare the groups concerning their pre- and post-

questionnaire scores and the variations between them. Additionally, paired-sample t-tests were used to compare the pre- and post-questionnaire scores within each group to examine how autonomy levels changed during the intervention.

Semi-structured interviews were conducted to gather the qualitative data. The thematic approach was used to analyze the data. The researcher started by reading the data several times to become familiar with it. Initial codes were generated from which the first themes were identified, and after revision, some were merged, and the final themes were defined and named.

4. Results

This section is guided by the research questions that prompted this study. The investigation unfolds a comprehensive analysis integrating numerical trends and nuanced qualitative insights.

4.1. RQ 1

The first research question aimed to identify the effect of using MALL on students′ perceived autonomy levels. Descriptive statistics were run on the data sets to compare the scores on each survey administration. Table 2 shows the means and standard deviations of the experimental and control groups.

	Pre-intervention Survey		Post-intervention Survey		Difference	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Experimental (n= 45)	3.667	.395	4.100	.181	0.433	-0.214
Control (n= 45)	4.085	.180	3.764	.065	-0.321	.115

Table 2. Experimental and control groups' autonomy level differences

As seen in Table 2, the experimental group's mean before the intervention (M= 3.667 / SD=.395) was lower than the mean result of the control group (M= 4.085 / SD=.180) measured simultaneously. Meanwhile, the difference in mean scores of the experimental group before (M= 3.677 / SD=.395) and after the intervention (M= 4.100 / SD=.181) is 0.433. These findings indicate that when the treatment was implemented, the experimental group had a higher level of learner autonomy than the control group. Nevertheless, t-tests were performed on the data to determine whether the results were statistically significant. The results can be observed in Table 3.

doi.org/10.32388/GARTGH.2

Group	Mean	Std. Dev.		Levene's Test for Equality of Variances		t-test for Equality of Means		
				F	Sig.	t	df	Sig.
Experimental before	3.667	.395	Equal variances assumed	0.399	0.561	0.584	61	0.000
Experimental after	4.100	.181						

Table 3. T-test experimental before v. after intervention

According to the figures depicted in Table 3, the p-value equals 0.561. ($P(x \leq -0.5842) = 0.2806$). This means the chance of rejecting the H0 is very high, standing at 56.12%. Furthermore, the test statistic T equals 0.5842, which is in the 95% region of acceptance: [-1.9996. 1.9996]. The difference in the mean scores between the pre- and post-intervention survey is in the 95% acceptance region [-7.8395. 7.8395], and the 95% confidence interval after minus before is [-10.1299. 5.5492]. The observed effect size d is very small, 0.074. This result indicates that the magnitude of the difference between the average of the differences and the expected average of the differences is very small. Finally, it can be said that the sample difference between the mean scores after and before the intervention is not big enough to be statistically significant.

Additionally, the researcher ran a second T-test to analyze if the differences in means of the survey after the experimental and control groups' intervention were positively statistically significant. Table 4 shows the results of the analysis.

doi.org/10.32388/GARTGH.2

Group	Mean	Std. Dev.		Levene's Test for Equality of Variances		t-test for Equality of Means		
				F	Sig.	t	df	Sig.
Experimental after	4.100	.181	Equal variances assumed	0.068	0.591	0.539	61	0.000
Control after	3.764	.065						

Table 4. T-test experimental v. control after intervention

According to Table 4, the p-value equals 0.591. (P(x≤ 0.5391) = 0.7041). This p-value means the chance of rejecting the H0 is very high, representing 59.18%. Furthermore, the test statistic T equals 0.5391, which is in the 95% region of acceptance: [-1.9996. 1.9996], and the 95% confidence interval of experimental minus control group is [-6.4242, 11.1661]. The observed effect size d is very small, 0.068. Thus, the results of the paired-t test indicated that there is a non-significant, very small difference between the results of the survey done by the experimental group after the intervention and the results of the survey done by the control group after the intervention.

Participants also gave their opinions on how they perceived using mobile phones in their English class affected their autonomy. Three themes resulted as the most common arguments during the interviews.

First, learners perceived that they could depend less on the teacher. Take Participant One's comment. She claimed, "With the things we did outside the class, you know, using the apps you recommended, it was nice and interesting. I began doing English exercises on weekends, things we did in class, but wanted to do more." In this same vein, Participant Three said, "In the past, I only did what the teacher said or assigned, nothing more, and only used the materials our teachers provided. But now I find myself looking for materials on the Internet. The only thing is I still have to ask you if they are beneficial." Finally, Participant 5 expressed, "I think I became more independent. I used to ask the teachers about the things I didn't understand, but now, with the apps I have on my mobile, I can find the answers by myself."

The second theme mentioned was how using mobile phones to practice English outside the classroom aided them in developing learning strategies that worked for them. Participant 6 said, "One of the things I have noticed is that since I am using some of the apps you suggested to practice our reading skills, I have learned that there are things I should do to understand the articles better. For example, I first look at the questions and do not read the entire article." Similarly, Participant Two said he used to look at every word he did not know in the dictionary. However, since using the recommended app, he has become accustomed to reading the sentences and guessing the meaning of the words from the context.

The last most common theme relates to the MALL implementation's effect on their autonomy by helping them plan their studies more effectively. Participants indicated that the access they had to lots of materials allowed them to make choices over them, which enabled them to be more organized in their self-studies outside class. In this regard, Participant 9 ascertained, "Before implementing MALL, I struggled to find materials outside my course readings relevant to my studies. Now, with access to a wide range of materials, I feel much more empowered to make informed choices about what I want to focus on in my self-studies outside of class. It's helped me be more organized and proactive in my learning." Here is what Participant Ten said, "Using my mobile phone has really helped me take charge of my own learning. I used to feel like I was limited to the materials presented in class. But now, I have the ability to access different materials on the go, which means I can plan my studies around my own schedule, which has given me a lot more autonomy and control."

Although the results from the survey are not statistically significant, it can be understood from learners' comments that they can see a positive effect of using their mobile phones to practice English skills.

4.2. RQ2

The second research question enquired about students' perceptions of using MALL in the English class. To obtain the answer to this question, the researcher relied on the participants' replies to the semi-structured interviews.

In this regard, Participant Five explained, "I find using my mobile phone to practice English really helpful. There are so many language-learning apps that make it easy to practice vocabulary and grammar. I can do short exercises during my commute or even play language games in my free time. It's like having a personal English tutor in my pocket!"

In the same vein, Participant One said, "I enjoy using my mobile phone to practice English because it allows me to watch English videos and listen to podcasts. It helps me improve my listening skills and exposes me to different accents and expressions. Also, I can do it anywhere, whether I'm at the park or waiting for the bus. It makes learning English more fun and convenient for me."

Participant Nine conveyed, "I think some of the apps you suggested are really amazing. I can chat with native speakers. It's a fantastic way to practice speaking and gain confidence in real-life conversations. I've made friends from different countries, and we help each other with our language skills. It's like having a global language study group right at my fingertips!"

Finally, Participant Three said, "Mobile phones make it easy for me to read English articles and news online. I can use news apps to stay updated with current events while practicing my reading skills. The convenience of having access to various English materials on my phone has made me more motivated to engage with the language outside of class. It's like turning my free time into productive learning moments."

The above participants' statements illustrate their positive opinions of using MALL to practice English, from the convenience of accessing learning materials anywhere and anytime to the social and collaborative aspects of language exchange apps. Using mobile phones has proven to be a valuable tool in augmenting language learning experiences.

4.3. RQ3

This investigation's last research question aimed to pinpoint the benefits and challenges of using MALL in an English as a foreign language class, as perceived by Ecuadorian polytechnic students. The data to answer this question come from the survey. Table 5 contains the survey descriptive analysis.

	N	Media	Desv. típ.	Meaning
Using English applications on my smartphone gives me greater control over my classwork	45	4.543	.562	Agree
English mobile applications enable me to accomplish tasks more quickly	45	4.342	.539	Agree
Using English mobile applications increases my productivity	45	4.514	.558	Agree
Using English mobile applications increases my English vocabulary, grammar mastery, and my pronunciation	45	4.285	.750	Agree
Using English mobile applications allows me to do more work than would otherwise be possible	45	4.382	.571	Agree
Using mobile applications makes it easier to learn the material	45	4.554	.750	Agree
Using English mobile applications enhances my effectiveness in my classwork	45	4.494	.562	Agree
I sometimes get distracted using social networks.	45	4.228	.689	Agree
I sometimes get distracted chatting with my friends.	45	4.457	.657	Agree
I sometimes lose my internet connection.	45	4.351	.645	Agree
I sometimes feel that I am not having enough physical contact with people.	45	4.285	.518	Agree
I have noticed my battery runs out faster	45	4.382	.731	Agree
My eyes feel tired after I spend a lot of time doing work on my mobile phone.	45	4.400	.650	Agree

Table 5. Benefits and Challenges of using MALL

According to Table 4, the benefit students deemed the most important has (M= 4.554 / SD=.750), and it reads that using mobile applications makes it easier to learn the material. The second-highest mean score contemplates using apps on the smartphone to procure greater control over students' classwork. This statement got (M= 4.543 / SD=.562). The following statement explains that using mobile apps to learn English learners can be more productive (M= 4.514 / SD=.558). Next is the statement that students can be more effective doing their classwork due to using mobile applications to practice English. This statement obtained (M=4.494 / SD=.562). The fifth most common benefit of using mobile phones to practice English outside the classroom, learners believed they could do more work than without them (M= 4.382 / SD=.571).

Meanwhile, the most common perceived challenge for respondents is the distraction of chatting with friends while using mobile phones (M= 4.457 / SD=.657). The second most common challenge is how much time they spend using their mobile phones and how their eyes are affected by feeling tired (M= 4.400 / SD=.650). Next, students perceive that due to using their mobile phones to practice English, their batteries start to run out faster (M=4.382 / SD=.731). Another issue that learners consider a disadvantage of using mobile phones is when they lose their Internet connection (M= 4.351 / SD=.645). The last negative effect learners claim is that they feel alone as they do not have enough physical contact due to doing activities on their mobile phones.

5. Discussion

This research investigated the impact of using MALL to practice English outside the classroom on undergraduate Ecuadorian polytechnic students' autonomy levels. The study used a mixed-method quasi-experimental design to answer three research questions.

The first research question aimed to determine how implementing MALL affects the self-perceived autonomy levels of undergraduate Ecuadorian polytechnic students. The T-tests between the experimental and control groups and the experimental group before and after the intervention did not show a statistically significant difference in autonomy levels. This result has also been reported before (Adara, 2020; Akman & Karahan,2023). However, during the semi-structured interviews, participants perceived a positive effect of MALL on their autonomy levels. Reports from other scholars support this finding (Alhadiah, 2020; Nuraeni et al., 2020).

The second research question aimed to investigate how undergraduate Ecuadorian polytechnic students perceive the use of MALL in their language learning experience. The findings revealed that most participants perceived MALL as an effective tool that enhanced their language learning experience (Miqawati, 2020; Akman & Karahan, 2023). The

participants noted that MALL improved their language skills more interactively and engagingly (Garcia Botero et al., 2019; Alhadiah, 2020; Al-Ahdal & Alharbi, 2021; Solihin, 2021). The qualitative findings further suggest that using MALL may positively impact learners' motivation and engagement in the learning process (Okumuş Dağdeler, 2018; Nuraeni, 2020; Akman & Karahan, 2023).

The third research question explored the benefits and challenges of using MALL in the English as a foreign language class, as perceived by undergraduate Ecuadorian polytechnic students. The findings of the survey revealed that the use of MALL provided various benefits, including flexibility in location and time of learning (Nuraeni et al., 2020; Arvanitis & Krystalli, 2021), increased motivation (Gutiérrez-Colón et al., 2020; Hsu & Lin, 2021; Shortt et al., 2021), and enhanced engagement in the learning process (Viberg et al., 2020; Shortt et al., 2021).

However, challenges with using MALL were identified, including distractions (Hsu & Lin, 2021; Solihin, 2021), such as chatting with friends while using mobile phones, and the amount of time spent on mobile phones, which can make learners feel tired (Ni'mah & Umamah, 2020; Zou et al., 2020), shorter battery life (Zou & Li, 2020), loss of internet connection (Al-Emran et al., 2019; Syafryadin et al., 2021), and the feeling of being alone without physical contact while doing activities on mobile phones (Żammit, 2022).

6. Conclusion

The introduction of technology into language learning has experienced a paradigm change in educational environments, especially with the advent of MALL applications. While the improvements in language learning thanks to MALL have been well documented in the literature, its specific influence on students' autonomy levels still requires further exploration. This study aimed to understand the benefits of MALL in promoting learner autonomy.

Results demonstrated no statistically significant difference in autonomy levels between the experimental and control groups. However, during the semi-structured interviews, participants revealed a positive effect of MALL on their autonomy. The study also examined how MALL enhanced students' language learning experience. The qualitative findings also suggest that MALL may positively impact learners' motivation and engagement in the learning process. The study also explored the benefits and challenges of using MALL in an English as a foreign language class. The survey revealed that MALL has benefits such as flexibility in the location and time of learning, increased motivation, and enhanced engagement.

Nonetheless, challenges were also identified. One of them is distraction since learners prefer to chat or look at their social networks. They also complained that their devices' batteries run out more quickly, losing their internet connection, and feeling lonely while doing activities on mobile phones.

Several implications stem from the findings reported in this study. Despite the lack of a statistically significant difference in autonomy levels between the experimental and control groups, the positive effects reported in the semi-structured interviews suggest a perceived value of MALL in improving learner autonomy. This finding highlights the importance of incorporating MALL into language curricula, thus catering to diverse learner preferences. Students can benefit from the engagement offered by MALL, leading to a richer language learning experience.

Educators can play a significant role in implementing MALL in the language classroom. Teachers should explore innovative ways to integrate mobile technologies into their methodologies. Professional development on incorporating MALL and strategies to overcome the identified challenges is imperative.

Department heads should consider allocating resources to develop and maintain a robust technological infrastructure, ensuring good Internet connectivity. Furthermore, they can plan professional development initiatives empowering faculty members to incorporate mobile devices in their teaching practices.

This study is not without limitations. One limitation of the study is the small sample size, which might not fully represent the population of language learners used for the experimental and control groups. Therefore, caution should be taken when generalizing these findings to more diverse educational contexts. It is suggested for future research to employ a more extensive and diverse sample, encompassing several language proficiency levels, cultural backgrounds, and demographics.

Another limitation is the short-term focus of the study, which depicts the immediate impact of MALL on autonomy, motivation, and engagement. The extent of the intervention might not capture the long-term evolution of these variables. Thus, future research should consider conducting a longitudinal study exploring the effects of MALL over an extended period, favoring a more comprehensive understanding of the impact on language learning.

Statements and Declarations

Funding Information

No funding was received for the study.

Conflict of Interest

No conflict of interest is present in the conduction or reporting of this study.

Data availability statement

Data will be made available upon request.

References

- Abidin, Z., Mathrani, A., Hunter, R., & Parsons, D. (2017). Challenges of integrating mobile technology into mathematics instruction in secondary schools: An

Indonesian context. *Computers in the Schools*, *34*(3), 207–222. https://doi.org/10.1080/07380569.2017.1344056

- Adara, R. A. (2020). Negative Effects of MALL on the Improvement of Learners' Autonomy and Motivation. In *The International Conference on Innovations in Social Sciences and Education (ICoISSE)* (pp. 613–622). Bandung; ICoISSE. Retrieved from https://conference.loupiasconference.org/index.php/ICoISSE/article/download/84
- Akman, E., & Karahan, P. (2023). ELT students' perceptions toward mobile-assisted language learning (MALL): Exploring its effects on motivation and learner autonomy. *International Journal of Educational Researchers*, *14*(2), 1–20. https://doi.org/10.29329/ijer.2023.565.1
- Al-Ahdal, A. A., & Alharbi, M. A. (2021). MALL in collaborative learning as a vocabulary-enhancing tool for EFL learners: A study across two universities in Saudi Arabia. *SAGE Open*, *11*(1), 215824402199906. https://doi.org/10.1177/2158244021999062
- Al-Emran, M., Malik, S. I., & Al-Kabi, M. N. (2019). A survey of Internet of Things (IOT) in education: Opportunities and challenges. *Toward Social Internet of Things (SIoT): Enabling Technologies, Architectures, and Applications*, 197–209. https://doi.org/10.1007/978-3-030-24513-9_12
- Albar, B. B., & Sari, I. M. (2020). Learning Technology Development through Podcasts for Auditory Learning Styles. In *Proceedings of the 3rd International Conference on Educational Development and Quality Assurance (ICED-QA 2020)* (pp. 170–174). West Sumatera, Andalas; Atlantis Press. Retrieved from https://www.atlantis-press.com/article/125952101.pdf
- Alhadiah, A. (2020). EFL learners' experience of a MALL-based Vocabulary Learning Tool. *Indonesian Journal of Applied Linguistics*, *10*(2), 283–291. https://doi.org/10.17509/ijal.v10i2.28590
- Alrefaai, I. (2019). Exploring EFL graduate students' attitudes toward, and use of, mobile phones in language learning. *Arab World English Journal*, (1), 70–84. https://doi.org/10.24093/awej/efl1.6
- Alsharari, N. M., & Alshurideh, M. T. (2021). Student retention in Higher Education: The role of creativity, emotional intelligence, and learner autonomy. *International Journal of Educational Management*, *35*(1), 233–247. https://doi.org/10.1108/ijem-12-2019-0421
- Andujar, A., Salaberri-Ramiro, M. S., & Martínez, M. S. (2020). Integrating flipped foreign language learning through mobile devices: Technology acceptance and flipped learning experience. *Sustainability*, *12*(3), 1110. https://doi.org/10.3390/su12031110
- Arvanitis, P., & Krystalli, P. (2021). Mobile Assisted Language Learning (MALL): Trends from 2010 to 2020 using text analysis techniques. *European Journal of Education*, *4*(1), 13–22. https://doi.org/10.26417/ejls-2019.v5i1-191
- Bernacki, M. L., Greene, J. A., & Crompton, H. (2020). Mobile Technology, learning, and achievement: Advances in understanding and measuring the role of Mobile Technology in education. *Contemporary Educational Psychology*, *60*, 101827. https://doi.org/10.1016/j.cedpsych.2019.101827
- Borg, S., & Alshumaimeri, Y. (2017). Language learner autonomy in a tertiary context: Teachers' beliefs and practices. *Language Teaching Research*, *23*(1), 9–38. https://doi.org/10.1177/1362168817725759
- Candela, A. (2019). Exploring the function of member checking. *The Qualitative Report*, *24*(3), 619–628. https://doi.org/10.46743/2160-3715/2019.3726
- Creswell, J. (2018). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Pearson Education.
- Dashtestani, R. (2015). Moving bravely towards Mobile Learning: Iranian students' use of mobile devices for learning English as a foreign language. *Computer Assisted Language Learning*, *29*(4), 815–832. https://doi.org/10.1080/09588221.2015.1069360
- Duchatelet, D., & Donche, V. (2019). Fostering self-efficacy and self-regulation in Higher Education: A matter of autonomy support or academic motivation? *Higher Education Research & Development*, *38*(4), 733–747. https://doi.org/10.1080/07294360.2019.1581143
- Fakih, A.-H. (2022). Learning through SMS in Saudi EFL classroom: An inter-university study of Learner Perceptions and achievement of autonomy. *Theory and Practice in Language Studies*, *12*(4), 665–675. https://doi.org/10.17507/tpls.1204.06
- Falah Alzubi, A. A. (2019). Smartphone-Mediated Language Learning Strategies and Learner Autonomy among Pre-university Learners in EFL Reading Context. *Journal of Humanities and Social Sciences Studies (JHSSS)*, *1*(3), 49–63. Retrieved from https://al-kindipublisher.com/index.php/jhsss/article/download/167/15
- García Botero, G., Botero Restrepo, M. A., Zhu, C., & Questier, F. (2019). Complementing in-class language learning with voluntary out-of-class MALL. does training in self-regulation and scaffolding make a difference? *Computer Assisted Language Learning*, *34*(8), 1013–1039. https://doi.org/10.1080/09588221.2019.1650780
- Gholami, H. (2016). Self-assessment and Learner Autonomy. *Theory and Practice in Language Studies*, *6*(1), 46–51. https://doi.org/10.17507/tpls.0601.06
- Ghorbani, N., & Ebadi, S. (2020). Exploring learners' grammatical development in Mobile assisted language learning. *Cogent Education*, 7(1), 1704599. https://doi.org/10.1080/2331186x.2019.1704599
- Godwin-Jones, R. (2019). Riding the digital wilds: Learner autonomy and informal language learning. *Language Learning & Technology, 23*(1), 8–25. https://doi.org/https://doi.org/10125/44667
- Gopalan, M., Rosinger, K., & Ahn, J. B. (2020). Use of quasi-experimental research designs in education research: Growth, promise, and challenges. *Review of Research in Education*, *44*(1), 218–243. https://doi.org/10.3102/0091732x20903302
- Gutiérrez-Colón, M., Frumuselu, A. D., & Curell, H. (2020). Mobile-assisted language learning to enhance L2 reading

comprehension: A selection of implementation studies between 2012–2017. *Interactive Learning Environments*, *31*(2), 854–862. https://doi.org/10.1080/10494820.2020.1813179

- Hazaea, A. N., & Alzubi, A. A. (2018). Impact of mobile assisted language learning on learner autonomy in EFL reading context. *Journal of Language and Education*, *4*(2), 48–58. https://doi.org/10.17323/2411-7390-2018-4-2-48-58
- Hoi, V. N. (2020). Understanding higher education learners' acceptance and use of mobile devices for language learning: A Rasch-based path modeling approach. *Computers & Education*, *146*, 103761. https://doi.org/10.1016/j.compedu.2019.103761
- Hsu, H., & Lin, C. (2021). Extending the technology acceptance model of College Learners' mobile-assisted Language Learning by incorporating psychological constructs. *British Journal of Educational Technology*, *53*(2), 286–306. https://doi.org/10.1111/bjet.13165
- Jeong, K.-O. (2022). Facilitating sustainable self-directed learning experience with the use of mobile-assisted language learning. *Sustainability*, *14*(5), 2894. https://doi.org/10.3390/su14052894
- Klimova, B. (2019). Impact of mobile learning on students' achievement results. *Education Sciences*, *9*(2), 90. https://doi.org/10.3390/educsci9020090
- Kohler, S., & Dietrich, T. C. (2021). Potentials and limitations of educational videos on YouTube for science communication. *Frontiers in Communication*, *6*. https://doi.org/10.3389/fcomm.2021.581302
- Lim, C.P., Wang, T., Nith, B., Mak, N. (2021). Closing the Urban-Rural Higher Education Quality Gap with Blended Learning in a STEM Course at Three Cambodian Universities. In: Lim, C.P., Graham, C.R. (eds) *Blended Learning for Inclusive and Quality Higher Education in Asia*. Springer, Singapore. https://doi.org/10.1007/978-981-33-4106-7_12
- Little, D. (2020). Language learner autonomy: Rethinking language teaching. *Language Teaching*, *55*(1), 64–73. https://doi.org/10.1017/s0261444820000488
- Miqawati, A. H. (2020). Pronunciation Learning, Participation, and Attitude Enhancement Through Mobile Assisted Language Learning (MALL). *ENGLISH REVIEW: Journal of English Education*, *8*(2), 211–217. https://doi.org/10.25134/erjee.v8i2.2118
- Mohammad, E., & Masoumi, A. (2021). The relationship between learning vocabulary via mobile (Mobile-assisted language learning) and Iranian EFL learners' social anxiety and loneliness. *Jordan Journal of Modern Languages and Literatures*, *13*(4), 775–800. https://doi.org/10.47012/jjmll.13.4.10
- Morikawa, C., Kobayashi, M., Satoh, M., Kuroda, Y., Inomata, T., Matsuo, H., Miura, T., & Hilaga, M. (2021). Image and video processing on mobile devices: A survey. *The Visual Computer*, *37*(12), 2931–2949. https://doi.org/10.1007/s00371-021-02200-8
- Morrow, R., Mintzes, B., Gray, G., Law, M. R., Garrison, S., & Dormuth, C. R. (2022). 148 eporting clinical trial findings as an ethical responsibility to research participants: A qualitative interview study. https://doi.org/10.1136/ebm-2022-ebmlive.43
- Newington, L., Alexander, C. M., Kirby, P., Saggu, R. K., & Wells, M. (2022). Reflections on contributing to Health Research: A qualitative interview study with research participants and patient advisors. *PLOS ONE*, *17*(12). https://doi.org/10.1371/journal.pone.0279354
- Ngo, T. T., Tran, T. T., An, G. K., & Nguyen, P. T. (2023). Students' perception towards learning massive open online courses on Coursera Platform: Benefits and barriers. *International Journal of Emerging Technologies in Learning (iJET)*, *18*(14), 4–23. https://doi.org/10.3991/ijet.v18i14.39903
- Ni'mah, D., & Umamah, A. (2020). Mobile-assisted on extensive reading: Students' voices. *English Education: Journal of English Teaching and Research*, *5*(1), 41–48. https://doi.org/10.29407/jetar.v5i1.14367
- Nuraeni, C., Carolina, I., Supriyatna, A., Widiati, W., & Bahri, S. (2020). Mobile-Assisted Language Learning (Mall): Students' perception and problems towards mobile learning in English language. *Journal of Physics: Conference Series*, *1641*(1), 012027. https://doi.org/10.1088/1742-6596/1641/1/012027
- Okumuş Dağdeler, K. (2018). *The Role of Mobile-Assisted Language Learning (MALL) in Vocabulary Knowledge, Learner Autonomy and Motivation of Prospective English Language Teachers* (thesis). Retrieved 2018, from https://acikbilim.yok.gov.tr/bitstream/handle/20.500.12812/5 sequence=-1.
- Olaleye, S. A., Ukpabi, D., Karjaluoto, H., & Rizomyliotis, I. (2019). Understanding technology diffusion in emerging markets. *International Journal of Emerging Markets*, *14*(5), 731–751. https://doi.org/10.1108/ijoem-01-2018-0055
- Ozer, O., & Yukselir, C. (2021). 'Am I aware of my roles as a Learner?' the relationships of learner autonomy, self-direction, and goal commitment to academic achievement among Turkish EFL learners. *Language Awareness*, *32*(1), 19–38. https://doi.org/10.1080/09658416.2021.1936539
- Patel, V. L., & Shortliffe, E. H. (2023). Designing and implementing mHealth technology: The challenge of meeting the needs of diverse communities. *BMJ Health & Care Informatics Online*, *30*(1). https://doi.org/10.1136/bmjhci-2023-100813
- Pazilah, F. N., Hashim, H., & Yunus, M. M. (2019). Benefits of Gamification Towards Different Learning Styles in Language Learning. *International Journal of Innovation, Creativity and Change*, *5*(6), 81–89. Retrieved from https://www.ijicc.net/images/vol5iss6/5608_Pazilah_2019_E_
- Peng, H., Jager, S., & Lowie, W. (2020). Narrative review and meta-analysis of MALL research on L2 skills. *ReCALL*, *33*(3), 278–295. https://doi.org/10.1017/s0958344020000221
- Puspitarini, Y. D., & Hanif, M. (2019). Using learning media to increase learning motivation in elementary school. *Anatolian Journal of Education*, *4*(2), 53–60. https://doi.org/10.29333/aje.2019.426a

- Rajabalee, Y. B., & Santally, M. I. (2020). Learner Satisfaction, engagement and performances in an online module: Implications for institutional e-learning policy. *Education and Information Technologies*, *26*(3), 2623–2656. https://doi.org/10.1007/s10639-020-10375-1
- Royce, C. S., Hayes, M. M., & Schwartzstein, R. M. (2019). Teaching critical thinking: A case for instruction in cognitive biases to reduce diagnostic errors and improve patient safety. *Academic Medicine*, *94*(2), 187–194. https://doi.org/10.1097/acm.0000000000002518
- Sari, F. M. (2020). Exploring English learners' engagement and their roles in the online language course. *Journal of English Language Teaching and Linguistics*, *5*(3), 349–361. https://doi.org/10.21462/jeltl.v5i3.446
- Saunders, M. N., & Townsend, K. (2016). Reporting and justifying the number of interview participants in Organization and Workplace Research. *British Journal of Management*, *27*(4), 836–852. https://doi.org/10.1111/1467-8551.12182
- Selwyn, N. (2023). Lessons to Be Learnt? Education, Technosolutionism, and Sustainable Development. In Sætra, H. S. (Ed.) *Technology and sustainable development: The promise and pitfalls of Techno-Solutionism* (pp. 71–83). Essay, CRC Press LLC.
- Shen, B., Bai, B., & Xue, W. (2020). The effects of peer assessment on Learner Autonomy: An empirical study in a Chinese college English writing class. *Studies in Educational Evaluation*, *64*, 100821. https://doi.org/10.1016/j.stueduc.2019.100821
- Shortt, M., Tilak, S., Kuznetcova, I., Martens, B., & Akinkuolie, B. (2021). Gamification in mobile-assisted language learning: A systematic review of Duolingo Literature from public release of 2012 to early 2020. *Computer Assisted Language Learning*, *36*(3), 517–554. https://doi.org/10.1080/09588221.2021.1933540
- Solihin, S. (2021). Using mobile-assisted language learning (MALL) to teach English in Indonesian context: Opportunities and challenges. *VELES Voices of English Language Education Society*, *5*(2), 95–106. https://doi.org/10.29408/veles.v5i2.3150
- Sophonhiranrak, S. (2021). Features, barriers, and influencing factors of mobile learning in Higher Education: A systematic review. *Heliyon*, 7(4). https://doi.org/10.1016/j.heliyon.2021.e06696
- Stratton, S. J. (2021). Population research: Convenience sampling strategies. *Prehospital and Disaster Medicine*, *36*(4), 373–374. https://doi.org/10.1017/s1049023x21000649
- Syafryadin, S., Pratiwi, V. U., & Wardhana, D. E. (2021). Pre-service english teachers' experience with various call applications: Hindrances and reflection. *Studies in English Language and Education*, *8*(1), 99–114. https://doi.org/10.24815/siele.v8i1.17609
- Syakur, Abd., Sugirin, & Widiarni. (2020). The effectiveness of English learning media through google classroom in higher education. *Britain International of Linguistics Arts and Education (BIoLAE) Journal*, *2*(1), 475–483. https://doi.org/10.33258/biolae.v2i1.218
- Taber, K. S. (2017). The use of Cronbach's alpha when developing and Reporting Research Instruments in science education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2
- Talan, T. (2020). The effect of mobile learning on Learning performance: A meta-analysis study. *Educational Sciences: Theory & Practice*, *20*(1), 79–103. https://doi.org/10.12738/jestp.2020.1.006
- Terzioğlu, Y., & Kurt, M. (2022). Elevating English language learners' speaking fluency and listening skill through a learning management system. *SAGE Open*, *12*(2), 215824402210999. https://doi.org/10.1177/21582440221099937
- Turnbull, D., Chugh, R., & Luck, J. (2020). Learning management systems: A review of the research methodology literature in Australia and China. *International Journal of Research & Method in Education*, *44*(2), 164–178. https://doi.org/10.1080/1743727x.2020.1737002
- Usry, J., Partington, S. W., & Partington, J. W. (2017). Using expert panels to examine the content validity and inter-rater reliability of the Ablls-R. *Journal of Developmental and Physical Disabilities*, *30*(1), 27–38. https://doi.org/10.1007/s10882-017-9574-9
- Viberg, O., Wasson, B., & Kukulska-Hulme, A. (2020). Mobile-assisted language learning through learning analytics for self-regulated learning (Mallas): A conceptual framework. *Australasian Journal of Educational Technology*, *36*(6), 34–52. https://doi.org/10.14742/ajet.6494
- Vohra, A., & Bhardwaj, N. (2017). From active participation to engagement in online communities: Analysing the mediating role of trust and commitment. *Journal of Marketing Communications*, *25*(1), 89–114. https://doi.org/10.1080/13527266.2017.1393768
- Williams, A., Fossey, E., Farhall, J., Foley, F., & Thomas, N. (2018). Going online together: The potential for mental health workers to integrate recovery-oriented E-Mental Health Resources into their practice. *Psychiatry*, *81*(2), 116–129. https://doi.org/10.1080/00332747.2018.1492852
- Yuan, C.-H., & Wu, Y. J. (2020). Mobile instant messaging or face-to-face? group interactions in cooperative simulations. *Computers in Human Behavior*, *113*, 106508. https://doi.org/10.1016/j.chb.2020.106508
- Zainuddin, Z., & Perera, C. J. (2017). Exploring students' competence, autonomy, and relatedness in the flipped classroom pedagogical model. *Journal of Further and Higher Education*, 1–12. https://doi.org/10.1080/0309877x.2017.1356916
- Zou, B., Yan, X., & Li, H. (2020). Students' perspectives on using online sources and apps for EFL learning in the Mobile-assisted language learning context. *Language Learning and Literacy*, 515–531. https://doi.org/10.4018/978-1-5225-9618-9.ch027
- Żammit, J. (2022). Is mobile game-based learning effective for international adults learning maltese? *Asian-Pacific Journal of Second and Foreign Language Education*, *7*(1). https://doi.org/10.1186/s40862-022-00157-2

Declarations

Funding: No specific funding was received for this work.
Potential competing interests: No potential competing interests to declare.