Received: 13 March 2022 | Revised: 18 August 2022 | Accepted: 23 October 2022

DOI: 10.1111/jcal.12753

ARTICLE

Journal of Computer Assisted Learning WILEY

Using WhatsApp increases language students' self-motivation and achievement, and decreases learning anxiety: A self-determination theory approach

Abdullah Alamer[1,2] | Ahmed Al Khateeb[1] | Lucas M. Jeno[3]

[1]College of Arts, Department of English, King Faisal University, Hofuf, Saudi Arabia

[2]School of Education, The Univeristy of New South Wales (UNSW), Sydney, Australia

[3]Department of Education, University of Bergen, Bergen, Norway

Correspondence
Abdullah Alamer, College of Arts, Department of English, King Faisal University, Saudi Arabia.
Email: alamer.aaa@gmail.com

Abstract

Background: Mobile-assisted language learning (MALL) has long been advocated to promote students' language study outcomes. However, little is known about how using instant messaging applications (an example of MALL) affect student motivation, language anxiety, and actual achievement.

Objectives: To help close this gap, we have conducted a quasi-experimental study, in which we have used self-determination theory to test a mediational process model, in an effort to understand the psychological mechanisms that underlie the effect of instant messaging applications on student outcomes.

Methods: Two groups of Saudi undergraduate students ($N = 447$) were recruited to participate in the study. Participants under the experimental condition were invited to engage in language-related tasks with their teacher outside of class through the WhatsApp application, whereas participants under the control condition received standard teaching. We applied partial least square structural equation modelling (PLS-SEM) to test our model.

Results and Conclusions: The results of the PLS-SEM showed that the total effects of using instant messaging applications on autonomous motivation and L2 achievement were significant but that language anxiety was influenced only indirectly and negatively through language achievement. Also, the PLS-SEM showed that our results have strong predcitive power indicating support for external validity.

Implications: Our results show that instant messaging applications can be used to facilitate interest and achievement and to decrease anxiety. Furthermore, we are contributing to L2 methodological literature by using applications of PLS-SEM in experimental designs that can help researchers and practitioners of motivational processes.

KEYWORDS

L2 achievement, L2 motivation, language anxiety, mobile-assisted language learning, self-determination theory, structural equation modelling

1 | INTRODUCTION

The development of digital technologies has provided new opportunities for using mobile phone devices in second language (L2) learning. The increased usage of these portable devices has enabled researchers and educators to investigate mobile-assisted language learning (MALL), or the effectiveness and usage of mobile devices and their applications to promote language learning (Önal et al., 2019; Wang, 2017; Wrigglesworth, 2020). MALL enables the learning of a language to occur with the assistance of technology and handheld devices such as smartphones. The investigation of such technologies and their applications in various teaching settings has grown in importance as mobiles are a part of learners' daily routines and their normal language classes (Walker & White, 2013). Shadiev et al. (2020) have argued that MALL can provide authentic environments capable of enhancing daily language learning and reducing cognitive loads.

This research attempts to explore the influence of one of the most popular interactive communication and instant messaging technologies, WhatsApp, which is a MALL application that is also within the overarching domain of computer-assisted language learning (CALL). CALL exploits the usage of various digital tools to create novel environments for language learners (Gillespie, 2020). In this paper, we attempt to link MALL with SDT, which argues that individuals are internally motivated to get involved in tasks when three psychologically universal needs–the so-called basic psychological needs (BPN) of autonomy, competence, and relatedness–are satisfied (Ryan & Deci, 2020).

1.1 | Research contributions and questions

It is of great importance to study the potential of WhatsApp and similar tools used for social networking purposes, as they have become influential in the provision of emotional and linguistic support. However, this topic has not yet been fully examined from an L2 perspective among language learners.

Currently, a major gap in the research is the lack of clarity over whether and how the use of instant messaging applications (an example of MALL) may lead to increased motivation and achievement and decreased language anxiety by way of an integrated motivational model. This issue is particularly relevant given the limitations indicated by recent research with regard to the effectiveness of MALL in the enhancement of autonomy and language engagement (García-Gómez, 2020; Jeno, Adachi, et al., 2019). Although instant messaging applications offer many benefits, a review of these applications as an out-of-classroom language activity has revealed several issues related to the research design, assessment of learning outcomes, and statistical procedures used in experimental studies to determine the usefulness of the application in L2 settings (Hair & Alamer, 2022; Tragant et al., 2021).

The present quasi-experimental research empirically investigates the effects of a popular instant messaging technology, WhatsApp, on language learning. Instant messaging applications have become popular: the number of users has dramatically increased everywhere. It is believed that social networking applications have an impact on learners' motivation and meet their psychological needs. In line with SDT (Ryan & Deci, 2017), this research explores the role of instant massaging technologies, specifically whether WhatsApp has a significantly positive effect on the learning experience. Also, from a methodological perspective, this study is the first to apply PLS-SEM for experimental data in the L2 domain. As such, this research addresses the following two research questions (RQs):

> **Research Questions RQ1.** *Will use of instant messaging applications in a language teaching context increase the L2 student's autonomous motivation and achievement and decreases their learning anxiety when compared to standard teaching?*

> **Research Questions RQ2.** *Are the BPN of autonomy, competence, and relatedness mechanisms that underlie the effect of instant messaging applications on the outcomes?*

2 | THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 | SDT in L2 learning

Motivation has become a fundamental subject for exploration by second language (L2) researchers, as it is considered a determinant of language proficiency (Ushioda, 2009). SDT is one of the most empirically supported theories in language-learning research (Alamer, 2021, 2022a; Noels, 2013). Central to SDT is the distinction between autonomous and controlled motivation to explain why individuals do what they do (Deci & Ryan, 1985; Ryan & Deci, 2020). In the L2 domain, autonomous motivation refers to the reasons for learning that are volitional and self-endorsed (Alamer, 2022a; Alamer & Alrabai, 2022). For instance, L2 learners may state that their learning of the L2 is an enjoyable endeavour and that they are interested in carrying out the language tasks. Controlled motivation, on the other hand, refers to reasons for learning that are external to the learner's self (Alamer, 2022d). For example, some L2 learners may simply be learning a language in order to obtain a prestigious job or to pass university tests without taking a deep interest in the subject.

Research in SDT shows that autonomous motivation leads to more sustained learning with less psychological distress as learners feel more enjoyment in their learning (Alamer, 2022a; Alamer & Lee, 2019). Autonomous motivation also promotes personal interest in achieving tasks and supports feelings of positive affect (Noels et al., 2019; Oga-Baldwin et al., 2017). Furthermore, several empirical studies support the positive relationships between autonomous motivation and varied language outcomes, including greater effort, greater willingness to communicate, less language anxiety, continued desire to learn the language, and

more positive self-evaluations (see McEown et al., 2014, for a review).

2.2 | BPNs and autonomous motivation

In addition to autonomous motivation, SDT provides a psychological mechanism through which autonomous motivation can be promoted and maintained. The theory stresses the fulfilment of the three BPNs of *autonomy*, *competence*, and *relatedness* as nutriments or supports for the development of autonomous motivation when carrying out academic tasks (Alamer, 2022b, 2022c). In essence, learners perceive the learning process as satisfying needs when the environment supports the need for autonomy (when students experience a sense of choice and volition in subject matter), competence (when students feel that they are effective at carrying out the activities and that learning tasks are optimally challenging), and relatedness (when learners experience a sense of care and belonging in a situation).

Research shows that the satisfaction of needs is related to an increase in autonomous motivation. For example, a longitudinal study by Oga-Baldwin et al. (2017) investigated the links between teaching style, need satisfaction, engagement, and motivation. They found that need-supportive teaching positively predicted greater need satisfaction, which in turn predicted engagement, which collectively predicted autonomous motivation. Similarly, Dincer et al. (2019) studied the perception of 412 Turkish EFL students of their teachers' supportiveness of autonomy. The researchers then assessed how this perception affected the satisfaction of the students' BPNs, which in turn affected their engagement, which in turn affected their L2 achievement. Similar results were found in a study by Alamer (2022a), although in Alamer's study the satisfaction of BPNs related to L2 achievement directly but not indirectly.

2.3 | Language anxiety

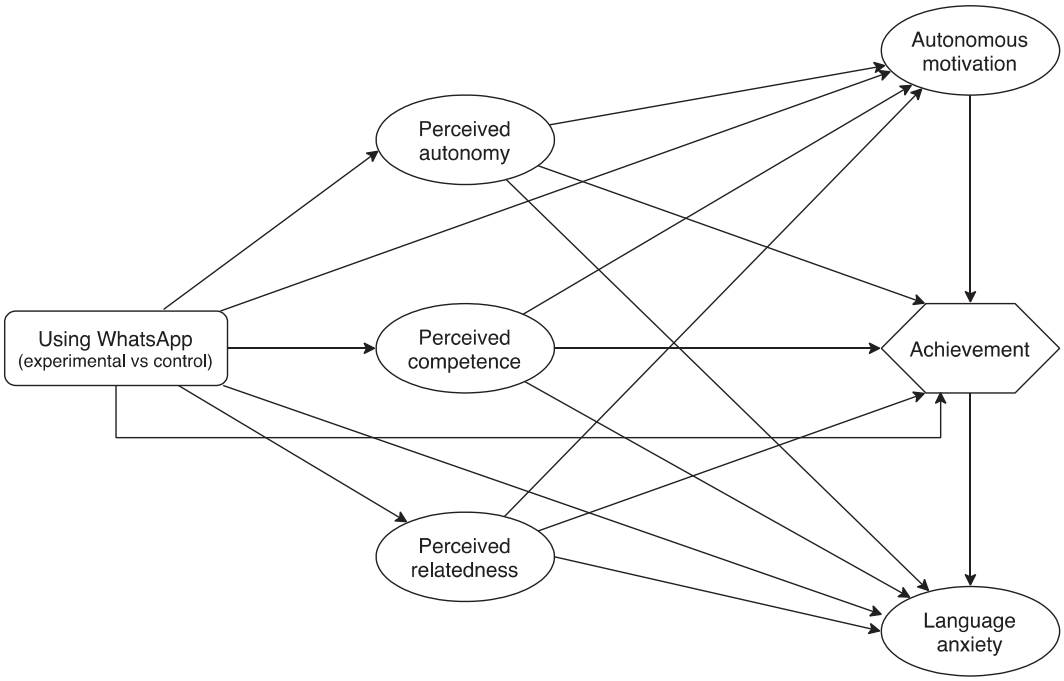
Anxiety during language learning is a major educational problem that is negatively related to the learning process. Language anxiety involves fear, worry, and negative feelings while using the L2 (MacIntyre & Gregersen, 2012). Language anxiety is a type of emotion that has been extensively investigated in the area of L2 learning (Alamer & Almulhim, 2021), and it plays a key role in learners' motivation and their interest in the process of learning. Whether language anxiety affects subsequent learning achievement is debatable (Botes et al., 2020). More specifically, a recent study that followed students over 4 months found that anxiety is affected by prior L2 achievement and not the other way around (Alamer & Lee, 2021). This directional relationship supports the theoretical perspective tested by Sparks and Alamer (2022), who see language achievement (both first and second) as an antecedent of anxiety. Accordingly, in the present paper, we build a hypothetical model according to these findings. In tandem with SDT, it is argued that the more learners' BPNs are satisfied, the less anxiety they report (Noels et al., 1999). Indeed, research finds that autonomous motivation contributes to lower levels of anxiety, fear, and embarrassment in the learning process (Alamer & Lee, 2019), presumably due to the inherently personal value and enjoyment of and interest in the activity.

2.4 | WhatsApp in language learning

Studies on WhatsApp have explicitly emphasized its affordances as the main reason for its popularity, acceptability, and sociability (Akkara et al., 2020). WhatsApp in L2 has been explicitly applied to resolve doubts, receive (grammar/content-based) feedback, and inspire individuals to feel more self-confident (Weissheimer et al., 2018). Alshammari et al. (2017), for example, identified three main uses of WhatsApp in L2 settings: to exchange information, to support informal language learning, and to provide more opportunities for language practice.

WhatsApp has been applied to various aspects of language learning, including reading (Gutiérrez-Colón et al., 2020), listening (Fauzi & Angkasawati, 2019), writing (Andujar, 2016), and speaking (Kheryadi, 2018). Additionally, research has focused on the positive effects of using WhatsApp on vocabulary acquisition (Liu, 2016), learner autonomy and individualisation (Alzubi & Kaur, 2018), and reduced language learner anxiety (García-Gómez, 2020; Shamsi et al., 2019). Kartal (2019) has reviewed the evidence suggesting that this tool is effective at boosting individuals' motivation and language attitudes, learning autonomy, and interaction and at lowering language-learning anxiety. However, some have argued that the use of instant messaging applications may not necessarily lead to positive outcomes (García-Gómez, 2020; Stockwell & Reinders, 2019). A study by Dehghan et al. (2017) reports that the use of WhatsApp did not result in significant benefits for technology-oriented groups compared to non-technology-oriented groups, although the participants preferred mobile technologies. These results were attributed to learners possibly being distracted by factors such as chats and links, and/or to codes of conduct apparently not being clear enough for the participants.

Further findings by García-Gómez (2020) show that individuals' lack of pragmatic competence can lead to a negative impact on interpersonal relationships, which can consequently produce negative perspectives toward the use of WhatsApp in learning L2. In addition, Karapanos et al. (2016) investigated the link between psychological needs and WhatsApp. They found that relatedness is the only predictor of the level of use of WhatsApp. However, they observed that relatedness and competence are among the most reported needs in this context. The researchers also found that WhatsApp supports social interaction among community members, which may, in turn, satisfy the psychological need for relatedness. Pike et al. (2011) indicated that such communities resulted in positive engagement, which in turn has positive effects on competence, relatedness, and achievement. However, few studies have integrated psychological needs, motivational orientations, and language anxiety within one comprehensive model based on SDT, as presented in the current study, which, therefore, seeks to fill this gap.



Note. Hexagon shape denotes a formative construct (see Hair & Alamer, 2022)

FIGURE 1 The hypothesised structural model of the effects of using WhatsApp on the study's variables. Hexagon shape denotes a formative construct (see Hair & Alamer, 2022).

2.5 | Applications of WhatsApp in L2 settings

The usefulness of WhatsApp in language learning has received considerable attention. WhatsApp has been utilized in different learning contexts to achieve different purposes. For example, it was used to carry out language-learning tasks in support of oral and written interaction and to reinforce social networks without paying too much attention to linguistic errors (Tragant et al., 2021). An intervention by Tragant et al. (2021) involved posing and answering questions from a list of topics in a WhatsApp group to practise the language and engage in real communication. WhatsApp has also been used as a sustainable learning tool in informal settings outside of language classes even after the completion of a course (Alqasham, 2018) to provide for feedback and facilitate conversation. Andujar and Salaberri-Ramiro (2019) reported on a similar WhatsApp intervention in foreign language classes that was intended to extend formal language-learning beyond the ordinary classroom.

Furthermore, Gutiérrez-Colón et al. (2016) have investigated the ability of WhatsApp to improve L2 English reading skills among university students who were given short reading activities three times a week over a period of 3 months. They received immediate feedback from the teacher and the target activities included multiple choice, gap filling, true/false statements, and open-ended questions. In another study, conducted in Saudi Arabia, a group of participants used WhatsApp and its features to share images, photos of summaries, and mind maps, look up new vocabulary, and train in accurate pronunciation and parts of speech (Hazaea & Alzubi, 2016). Furthermore, the participants in a 12-week study by Alzubi and Kaur (2018) experimented with WhatsApp and other social-oriented applications to explore social strategies related to asking for clarification and correction, cooperating, and emphasizing with language users inside and outside the classroom.

2.6 | Addressing the gap in previous research

Recent research conducted by Alamer and Al Khateeb (2021) shows a link between BPNs and autonomous motivation using SEM. Alamer and Al Khateeb used a repeated measure of ANOVA to test differences over time. Their results show that the effect of autonomy at Time 1 on autonomous motivation at Time 2 was significant in the experimental group exclusively. Although Alamer and Al Khateeb's results were encouraging, their analysis was lacking in three important respects: (i) the SEM employed was merely a multigroup analysis, which thus provided insufficient support for a claim of causality between the variables in the two groups; (ii) the study did not account for additional educational outcomes when using WhatsApp, including language anxiety and achievement; and (iii) the research used the Covariance-based SEM method to assess the model's predictive power, but in such situations, the PLS-SEM method is more appropriate (this is addressed in a later section).

Based on the information from the previous studies reviewed above and the conceptualisation of SDT, the structural model of the present study (Figure 1) has been hypothesised as follows: (H1) the use of WhatsApp (relative to the control condition) will increase participants'

autonomous motivation and language achievement but decrease their language anxiety; (H2) the BPNs will be the mechanisms underlying the positive effects of the intervention on autonomous motivation and language achievement, but they will negatively mediate the effect of the intervention on language anxiety; (H3) autonomous motivation will relate to an increase in achievement which in turn will decrease language anxiety.

3 | METHOD

3.1 | Participants

The participants in the present study were drawn from a convenience sample consisting of Saudi undergraduate students enrolled at two public universities in Saudi Arabia. Participants from one university were selected 'to be the experimental group, and participants from the other university were selected to be in the control group. This research was carried out at two different times during the academic term according to the following numbers. The control group consisted of 131 students at the initial (time 1) measurement point (males = 75 and females = 56) and 103 students at the follow-up (time 2) measurement point (males = 65 and females = 38). At the initial (time 1) measurement point the experimental group consisted of 316 students (males = 68 and females = 248), whereas at the follow-up (time 2) measurement point, it consisted of 160 students (males = 44 and females = 116).

The participants' ages were in the range of 18–20. At the time of investigation, the participants were in their foundation year of study, when they were required to pass the English placement test to be allowed to enter the programme and be assigned to level 1. Those who showed distinguished language proficiency on the placement test were automatically put into the next level (level 2). With reference to the Common European Framework of Reference (CEFR), level 1 students were in the lower-intermediate to intermediate range. Only level 1 students were recruited for this study. The language levels of the participants are thus believed to be similar. Both groups had similar curricula, learning tasks, course descriptions, learning objectives, outcomes, and test procedures. As far as the experimental group is concerned, the participants were expected to interact in view of several procedures that were being considered. Clear rules were set regarding how everyone should be treated, to the effect that the participants were to treat one another with respect for one another's dignity within a safe and trusting environment. The participants were encouraged to interact by expressing their opinions in non-offensive language and by showing their multicultural backgrounds along with offering one another social, emotional, and learning support to achieve the learning outcomes of the tasks.

3.2 | Procedure

This study is an intervention study taking a quasi-experimental approach at two measurement points: an initial (time 1) measurement and a follow-up (time 2) measurement. This quasi-experiment consisted of two conditions: an experimental condition group and a control condition group. Both groups completed the initial and follow-up (self-reported) measurements before and after the intervention. There was a gap of roughly 15 weeks between the time points at which the data was collected; this time gap was deemed sufficient in order to observe changes in the students' motivation, anxiety, and achievement. The time 1 data collection commenced during the second week of the semester to ensure that the students had begun their studies and settled into the courses. The time 2 data collection was carried out during the second week of the following semester. All of the students were invited to complete an online questionnaire and it was emphasized that participation was competently voluntary. The same procedures were followed during the next visit (time 2).

The control group experienced standard teaching, which included carrying out learning tasks that were to be completed via ordinary methods using paper and pen (i.e., a typical language classroom). They were not permitted to use WhatsApp or other tools to accomplish assigned learning tasks. The experimental group, on the other hand, experienced similar teaching as did the control group but participants were given additional learning tasks which were tailored for delivery through a WhatsApp group. Participants in the experimental group were asked to interact with 10 topics for 5 weeks (two topics were allocated per week) in a WhatsApp group dedicated to this purpose. The topics of the additional tasks were deliberately selected to allow greater opportunity for personal reflection and social engagement, as well as to reflect the individuals' real-life contexts, and made reference to real websites (e.g., BBC Learning English and BBC Sounds) as shown in Appendix A. These topics were specifically selected to suit the participants' language proficiency level and to allow them to promote their language skills by listening to and reading about interesting information and entertaining subject matter and writing answers to questions.

The main differences between the groups were the opportunities the experimental group had to share their thoughts, exchange content through the WhatsApp group, and do optional tasks. The participating students were expected to collaborate via WhatsApp on the assigned tasks, which focused on stimulating the students' understanding and critical thinking by way of listening and reading skills. A deadline was set one of the 10 assigned tasks to be completed and then shared with the rest of the group members via WhatsApp every Thursday.

As far as the interaction between instructors and teaching assistants on WhatsApp is concerned, they were asked to present each week's topic to the participants along with clear instructions to the participants to share their thoughts, videos, voice recordings, and so on. As there were two classes per week, the instructors were asked to allocate the first 15 min of the second class each week to promote in-class interaction, group communication, and peer feedback. The instructors' role also included complimenting various participants and providing general feedback in response to what the participants provided. It must be noted that before the experiment was conducted, the instructors were trained to in the appropriate use of WhatsApp (i.e., to ensure that the participants were comfortable, engaged, and more eager to share), which included essential social media etiquette.

3.3 | Measures

3.3.1 | Psychological need satisfaction

The first scale used was the BPN-L2 (Alamer, 2022a) which assesses the satisfaction of students' basic needs of autonomy, competence, and relatedness on 12 items based on a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). Example items include "I am able to freely decide my own English learning pace" (autonomy), "I feel that I am capable of learning English" (competence), and "My English teacher cares about my progress" (relatedness). See Appendix B Tables B1–B3.

3.3.2 | Autonomous motivation

The second scale was an adaptation of the SDT-L2 (Alamer, 2022a; see also Alamer (2021) for an extensive validation study), which assesses students' autonomous motivation on 10 items based on a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). This scale starts with the following statement: "Why are you learning English?" It then ascertains the extent to which the participants agree with other relevant items, such as "Because I enjoy learning English."

3.3.3 | Language anxiety

The third scale used was the language classroom anxiety scale, which was taken from Gardner (2010). It assesses students' language anxiety in connection with 10 items and has a 5-point Likert-scale format for responses, which range from 1 (strongly disagree) to 5 (strongly agree). An example item is "I never feel quite sure of myself when I am speaking in our English class."

3.3.4 | Achievement

Finally, to assess L2 achievement, we obtained the official university records of the students' English scores at the end of the semester. These English scores are a summated score consisting of four language skill domains (subjects, i.e., listening, speaking, reading, and writing), with potentially five points for each domain. Hence the maximum score a student could achieve was 20, which represents excellent progress. The participants were asked to provide their consent for their English scores to be used for research purposes; three students did not consent, thus all of the responses in these cases were omitted.

3.4 | Data analysis

We used PLS-SEM to analyse the structural model, as this method is capable of handling non-normal data, small-sized samples, as well as focusing on the predictive power of the model (readers are referred to Hair and Alamer (2022) for a comprehensive discussion of PLS-SEM in education and L2 research). In addition, repeated measures ANOVA was applied to capture changes over time. In our correlational analysis, we used Spearman's rho (ρ) to account for the nonormality.

3.5 | Assessing SEM reliability and validity

Within the framework of PLS-SEM, the assessment was carried out by inspecting the measurement model reliability and validity. The reliability of the measures is evaluated by two indices: Cronbach's alpha (α) and composite reliability (CR). In both tests, values of 0.70 or above are indicative of a reliable measure. The validity of the measurement model is evaluated in two steps: (i) consideration of the average variance extracted (AVE), where values above 0.50 are recommended; and (ii) evaluation of the discriminant validity by way of checking the heterotrait-monotrait (HTMT) ratio of the correlations, where an advised cut-off value of 0.85 or below is preferable.

3.6 | Assessing SEM predictive power

The quality of the structural model was assessed according to three criteria, including (i) the coefficient of determination (R^2) in the dependent variables, where R^2 values 0–0.10, 0.11–0.30, 0.30–50, and >0.50 are indicative of weak, modest, moderate, and strong (Hair & Alamer, 2022) and (ii) the model's out-of-sample predictive power (i.e., $PLS_{predcit}$), in which the model is tested on the basis of a training sample (out-of-sample) and its predictive power assessed.

4 | RESULTS

4.1 | Missing data and data distribution

No data was found to be missing on one or more items in the SEM model. Additionally, a review was carried out to identify participants (i.e., who participated at only one time point etc.). In total, 69 cases were identified and removed from the analysis. Normality was also considered. The descriptive statistics shown in Table 1 suggest that the data is normally distributed.

4.2 | Repeated measures of ANOVA

Repeated measures of ANOVA (RM-ANOVA) were conducted to ascertain whether differences in the participants observed between time 1 and time 2 could be attributed to the product of time × condition. The results showed the two outcome variables to be significantly different over time: autonomous motivation F (1, 225) = 28.85, p < 0.01, η^2_p = 0.14, and language anxiety F (1, 225) = 10.81, p < 0.01, η^2_p = 0.06. As such, the students in the experimental group

TABLE 1 Means, SD and data distribution

	Control $N = 131$ vs. Experimental $N = 94$	Achievement	Autonomy T1	Competence T1	Relatedness T1	Autonomous motivation T1	Anxiety T1	Autonomy T2	Competence T2	Relatedness T2	Autonomous motivation T2	Anxiety T2
Mean	Control	12.59	3.77	4.05	3.56	4.08	2.72	3.76	4.18	3.50	3.99	2.58
	Experimental	15.77	3.94	3.40	4.01	2.59	3.48	4.27	3.41	4.28	2.94	2.91
SD	Control	5.34	0.75	0.72	0.75	0.66	1.33	0.83	0.71	0.73	0.78	1.15
	Experimental	4.69	0.67	0.88	0.56	0.71	0.88	0.67	0.90	0.53	0.66	1.10
Skewness	Control	−0.60	−0.37	−0.46	−0.45	−0.58	0.24	−0.49	−0.42	−0.26	−1.32	0.28
	Experimental	−0.82	−0.37	−0.51	0.00	0.43	−0.42	−0.57	−0.51	−0.54	0.12	0.07
Kurtosis	Control	−0.98	0.04	0.20	1.22	1.16	−1.15	0.37	−0.37	−0.25	2.75	−0.74
	Experimental	−1.02	0.48	−0.04	0.32	0.66	0.23	−0.30	−0.07	0.11	−0.10	−0.79

(which used WhatsApp) showed increased scores in autonomous motivation and reduced scores in language anxiety relative to the participants in the control group (standard teaching). According to Cohen et al. (2011), values of $\eta^2_p = 0.06$ and $\eta^2_p = 0.14$ can be considered medium and large in magnitude, respectively. A *t*-test was conducted to ascertain whether the two groups had different mean scores on achievement. The result showed significant differences (experimental $M = 15.77$, control $M = 12.59$, $t = 218.0$, $p < 0.001$, Cohen's $d = 2.89$). According to Plonsky and Oswald (2014), a value of $d = 2.89$ can be said to be large in magnitude. Accordingly, hypothesis H1 is supported.

4.3 | Assessing the measurement model

The assessment of the measurement model was begun by checking the reliability indices of the constructs involved in the study. As shown in Table 2, the values of Cronbach's alpha (α) and composite reliability (CR) were all above the cut-off value of 0.70, with the exception of autonomy, which was nonetheless near the acceptable level. One can also see in Tables 2 and 3 that the AVE and HTMT results are evidence of convergent and divergent validity.

4.4 | Evaluating the structural model quality

The results of the PLS-SEM can be seen in Figure 2 and Table 4 for the correlation. The R^2 values of the outcome variables ranged between 0.26 and 0.46, indicating medium to strong effect sizes. Specifically, the model constructs had strong predictive power for autonomous motivation (approximately 46% of the variance was explained), followed by language anxiety (34%), and language achievement (26%). Lastly, we ran the $PLS_{predict}$ analysis and its results are reported in Table 5. According to Table 5, the PLS model was freer of error (i.e., RMSE) than the naïve benchmark. We have concluded that the structural model is meaningful and that it adequately predicted the outcomes.

4.5 | Assessing the mediational pathways from WhatsApp use to outcomes

To examine the mediational effects, a 5000 bootstrap subsample analysis was conducted. The model showed a direct increase in autonomous motivation and L2 achievement in the experimental group, indicating medium effect sizes. The specific indirect effects were all insignificant with one exception, observed in the experimental group in respect of language anxiety through the mediation of L2 achievement. As shown in Table 6, the total indirect effects failed to attain statistical significance. However, total effects were observed that were significant in respect of autonomous motivation with a medium effect size and L2 achievement with a large effect size. Overall, the

Autonomy T2	Competence T2	Relatedness T2	Autonomous motivation T2	Anxiety T2
AVE = 0.74	AVE = 0.88	AVE = 0.76	AVE = 0.77	AVE = 0.89
α = 0.68	α = 0.86	α = 0.72	α = 0.87	α = 0.88
CR = 0.79	CR = 0.91	CR = 0.80	CR = 0.90	CR = 0.92

Abbreviations: AVE, average variance extracted; α, Cronbach's alpha; CR, composite reliability.

TABLE 2 Reliability indices and convergent validity

TABLE 3 Discriminant validity based on heterotrait-monotrait ratio (HTMT) statistic

	Anxiety T2	Autonomy T2	Autonomous motivation T2	Competence T2	Achievement T2	Relatedness T2
Anxiety T2	1					
Autonomy T2	0.20	1				
Autonomous motivation T2	0.16	0.07	1			
Competence T2	0.36	0.28	0.36	1		
Achievement T2	0.56	0.43	0.20	0.45	1	
Relatedness T2	0.04	0.37	0.14	0.09	0.34	1

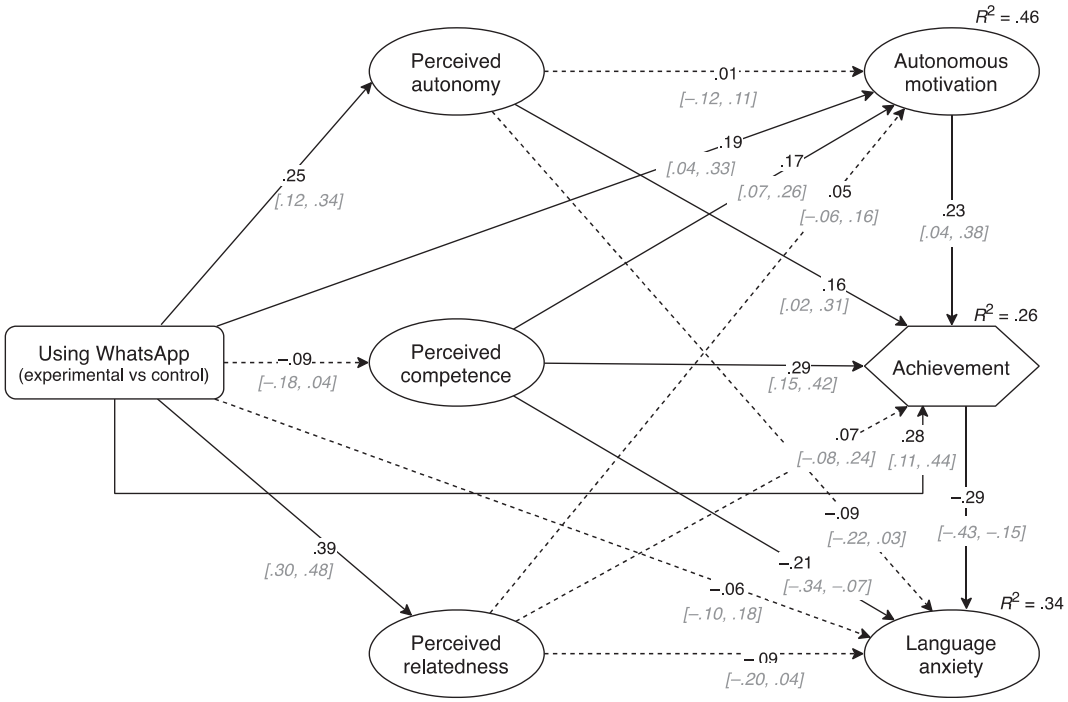


FIGURE 2 The structural model shows the effects of using WhatsApp on the study's variables. Dash lines are not significant. Italic and grey values represent the 95% confidence interval. The control condition group is coded "1" and the experimental condition group is coded "2."

results showed different types of relationships linking the intervention with outcome variables; the intervention directly increased students' autonomous motivation, moderately enhanced their L2 achievement, and indirectly decreased their anxiety. Thus, hypothesis H2 is partially supported. In addition, hypothesis H3 posits that autonomous motivation will relate to an increase in achievement, which in turn will decrease language anxiety. This is supported by the indirect negative effect observed in the analysis ($\beta = -0.07$, $p = 0.01$).

5 | DISCUSSION

The present study has sought to explore the effects of using WhatsApp to influence L2 students' autonomous motivation, language anxiety, and language achievement on the basis of SDT. In general, our findings support the hypotheses that students who use WhatsApp with their teachers experience a greater increase in autonomous motivation and language achievement together with a decrease in language anxiety.

TABLE 4 Correlations between the variables in the structural model (Spearman's ρ)

	Anxiety T2	Autonomy T2	Autonomous motivation T2	Competence T2	Achievement	Relatedness T2	Groups control = 1 experimental = 2
Anxiety T2	1						
Autonomy T2	−0.18	1					
Autonomous motivation T2	−0.14	0.07	1				
Competence T2	−0.34	0.28	0.35	1			
Achievement T2	−0.38	0.32	0.03	0.26	1		
Relatedness T2	−0.05	0.35	0.14	0.1	0.26	1	
Condition control = 1 Experimental = 2	0.08	0.33	0.64	−0.20	0.21	0.56	1

TABLE 5 RMSE values of items in the PLS-SEM (in-sample) model and the naïve benchmark (out-of-sample) model

	PLS-SEM model RMSE	Naïve benchmark model RMSE
Autonomous motivation item 1	**0.465**	0.494
Autonomous motivation item 2	**0.649**	0.693
Autonomous motivation item 3	**0.712**	0.784
Autonomous motivation item 4	**0.715**	0.782
Autonomous motivation item 5	0.503	**0.468**
Autonomous motivation item 6	0.520	**0.518**
Autonomous motivation item 7	0.452	**0.450**
Autonomous motivation item 8	**0.555**	0.584
Autonomous motivation item 9	**0.621**	0.629
Autonomous motivation item 10	**0.400**	0.422
Anxiety item 1	**0.921**	0.925
Anxiety item 2	**1.304**	1.340
Anxiety item 3	1.188	**1.186**
Anxiety item 4	0.985	**0.959**
Anxiety item 5	**0.816**	0.830
Anxiety item 6	**1.124**	1.141
Anxiety item 7	**1.179**	1.204
Anxiety item 8	**0.942**	0.977
Anxiety item 9	**0.831**	0.839
Anxiety item 10	0.989	**0.944**
Achievement item 1	0.799	**0.735**

Note: Lower error prediction (RMSE) values are in bold.

The results from our repeated measure of ANOVA were particularly supportive of our hypothesis. Autonomous motivation was found to be the largest variable that changed over time; students' autonomous motivation seemed to benefit from this intervention. This effect may be due to the positive experiences associated with autonomous motivation. In other words, when students are performing an activity for autonomous reasons, they are doing something they find personally valuable, meaningful, or enjoyable (Alamer, 2022a). Using WhatsApp may be interesting and enjoyable for the students, and this may account for the positive increase in autonomous motivation. The second-largest change observed in the findings was associated with language achievement. The experimental group appears to have achieved higher scores than the control group, as indicated by the *t*-test based on the post-test measurement only.

With regard to language anxiety, it was found that students became significantly less anxious about learning a language over time as they became involved in additional instant messaging applications and learning tasks with their language teachers. Overall, the lessening of language anxiety from pre-test to post-test is consistent with studies by Han and Keskin (2016) and Shamsi et al. (2019), who found a negative relationship between WhatsApp use and lower levels of learner anxiety. It is also consistent with the expression that anxiety is a consequence, not an antecedent, of language-learning processes (Alamer & Lee, 2021; Sparks & Alamer, 2022). For example, students may receive content-specific feedback and scaffolding from their teachers, which in turn may reduce their language anxiety. Additionally, having the ability to spend more time practising and working at one's own pace with instant messaging applications than is possible when using pen and pencil may serve to further decrease anxiety.

The results from our motivational process model generally supported our hypotheses, although some interesting findings emerged. These supported the positive effect of WhatsApp on perceived autonomy and relatedness when compared to the control group condition. This may be due to affordances within WhatsApp that facilitate meaningful choices, working at one's own pace, collaboration, and social support. Unexpectedly, however, the effect of WhatsApp on perceived competence remained insignificant. This may be due to a lack of effectance-relevant feedback from teachers when using the app. Future studies should investigate this further. The findings of the mediational model indicated that the effects of WhatApp on autonomous motivation were strong. This is in line with the SDT argument, which posits that language-learning tasks that enhance students' basic needs of autonomy, competence, and relatedness lead to greater adoption of autonomous types of motivation (Alamer, 2022a, 2022b; Alamer & Alrabai, 2022). Overall, this observation is also consistent

TABLE 6 Bootstrap analysis of total indirect effects and total effects of the intervention on the outcomes

	β	p value	95% CI	
			Low	High
Autonomous motivation - total indirect effect	0.001	0.97	−0.04	0.06
Autonomous motivation - total effect	0.19	**< 0.00**	**0.05**	**0. 33**
Language anxiety - total indirect effect	−0.06	0.18	−0.15	0.02
Language anxiety - total effect	**−0.002**	**0.98**	**−0.13**	**0.13**
L2 achievement - total indirect effect	0.04	0.34	−0.06	0.12
L2 achievement - total effect	0.32	**< 0.00**	**0.18**	**0.45**

Note: The bold values indicate significance at $p < 0.05$.

with previous research on the effectiveness of mobile applications for enhancing students' autonomous motivation (Alamer, 2015; Alamer & Al Khateeb, 2021; Jeno, Adachi, et al., 2019; Jeno, Vandvik, et al., 2019). More specifically, our evidence points to the robustness of this effect in the context of WhatsApp. This is not surprising, given that students often show interest and enjoyment while using such mobile applications. Hence, utilizing this application for language learning seems to be an enjoyable experience that also facilitate learning.

In addition to autonomous motivation, we found perceived autonomy and competence to be positive predictors of achievement. This is in line with previous studies that have found that satisfaction of needs for autonomy and competence enhances autonomous motivation and, in turn, increases achievement (e.g., Alamer, 2021, 2022a, 2022c; Alamer & Lee, 2019; Jeno, Vandvik, et al., 2019), presumably because students are performing activities out of personal choice and volition and mastering optimally challenging tasks. In addition, the mediational model supports our hypothesis on the total effects of instant messaging application use on increasing language achievement. Our findings on these effects thus concur with previous studies showing the positive influence of MALL on various linguistic outcomes, including reading skills and competence (Keezhatta & Omar, 2019) and improvement in L2 learners' acquisition of vocabulary when using MALL applications (Ahmad et al., 2017). Our current results extend this literature by pointing to the psychological mechanisms underlying the attainment of language skills within the mobile learning domain.

Although WhatsApp had a minimal direct effect on language anxiety, in the mediational process the indirect effect was meaningful. More specifically, we found an indirect effect on language anxiety through language achievement. This is important, because although elements of WhatsApp do not reduce language anxiety, the facilitation of learning does in turn decrease language anxiety, which may have important implications for pedagogical practices when using mobile learning tools such as WhatsApp. Of the three psychological needs, only perceived competence was a significant and negative predictor of language anxiety. This effect is likely due to student's feelings of progress, mastering language skills, and receiving corrective feedback, which in turn reduce language anxiety.

As regards statistics, we applied PLS-SEM as an alternative to the widely used Covariance-based SEM to investigate the predictive power of our structural model. PLS-SEM is more suitable when researchers are concerned with predicting both in sample and out of sample, both of which are supported in the R^2 and $PLS_{predict}$ analyses (Hair & Alamer, 2022). Therefore, the results suggest that our findings can be generalized to samples that are similar to the present context and to similar learning settings. In particular, the $PLS_{predict}$ analysis supported the external validity of our findings.

5.1 | Educational implications

This research reveals pedagogical implications for the use of the WhatsApp application in particular and MALL in general. It appears that WhatsApp can provide university students with significant encouragement and thus help them to better master language skills and components of the target language during language classes. This includes enrichment in the areas of listening, speaking, reading, and writing. Nevertheless, WhatsApp is a technology tool (Clark, 1983) and is thus dependent on instructors providing clear structures for usage and creating appropriate learning tasks. Effective use of this tool also involves evaluating the progress of students' learning as a whole and providing feedback upon the conclusion of tasks. As the intervention in the study shows, learners were encouraged to practise personalized learning with minimal dependence on instructors. They were inspired to create a positive environment characterized by a sense of working and sharing knowledge online within a community of practice (Lave & Wenger, 1991). The instructors were happy to provide general feedback to the experimental group to make the experience more effective for all of the participants in the WhatsApp group. This practice offered a form of L2 learning within a more secure, less threatening, atmosphere.

The results of this research should be taken into consideration when schools and universities need to shift from face-to-face to online forms of interaction (such as during the COVID-19 pandemic). However, WhatsApp alone cannot replace traditional teaching (e.g., use of coursebooks, teacher instruction, and synchronous discussion) but should serve as an aid to complement it. At the same time, use of WhatsApp appears to facilitate students' autonomous motivation in the learning process. This may be accounted for by self-

directed learning opportunities (which may account for perceived autonomy) and opportunities for collaboration both between the learners themselves and between learners and their instructors on WhatsApp (which may account for perceived relatedness) (Alamer & Al Khateeb, 2021). Our study suggests that these tools could be used in the design of learning in order to promote informal, "anytime, anywhere" language learning. This may have important implications for students learning a foreign language and teachers using technology to support student learning, as it enhances students' autonomous motivation to learn a foreign language and reduces their language anxiety. This is turn has implications for language learning as demonstrated by the effects on achievement, a well as practical implications in terms using the foreign language due to less language anxiety. However, our results suggest that these technologies need to help satisfy the psychological needs for autonomy, competence, and relatedness in order to increase learning and motivation.

5.2 | Limitations

The present study undoubtedly has some limitations. Firstly, it does not account for the pre-test measure of the students' achievement and accounts only for the post-test measure. Thus, the claim regarding cause and effect over time is limited, although the motivational process model did predict an increase in achievement. To address this limitation, future research should assess language levels before beginning the experiment. Secondly, the present research assesses the usefulness of only one application (WhatsApp) on student outcomes as an example of MALL in general. The results can be generalized as relevant to applications that offer similar functionalities (i.e., other instant messaging applications) and when the learning context is similar to that of the present study. However, to more precisely assess the effectiveness of MALL on student outcomes, further research should extend our results to other learning contexts. Lastly, the present study employs a homogeneous sample of Saudi undergraduate students learning English as a foreign language. The generalisability of our results to other countries and study levels and to processes of learning other L2s is limited. However, given the SDT claim of universality, wherein all humans, independent of gender, culture, and age, have three BPN for autonomy, competence, and relatedness, the satisfaction of which has implications for positive and negative outcomes (Ryan & Deci, 2017), we believe that our results and design may have some external validity. However, future studies should test this claim.

6 | CONCLUSION

The present study has sought to examine the impact of using WhatsApp, an instant messaging application, on students' autonomous motivation, language anxiety, and actual language achievement. To do this, we conducted a quasi-experimental study to understand the underlying psychological mechanisms in the use of instant messaging applications and the effects on student outcomes; we used SDT as a framework in order to test a mediational predictive model. Our results indicate that the use of instant messaging applications has significant total effects on autonomous motivation and L2 achievement, but that language anxiety was only indirectly and negatively influenced by facilitated learning. Empirically, our results show that instant messaging applications can be used to facilitate motivation and achievement and decrease anxiety. We applied the PLS-SEM technique to evaluate the predictive capability of our SEM model, which appears to be satisfactory and thus supports the external validity of our findings for similar learning contexts with similar instant messaging applications within a MALL setting. We showed an empirical example of using.

ACKNOWLEDGMENT

Open access publishing facilitated by University of New South Wales, as part of the Wiley - University of New South Wales agreement via the Council of Australian University Librarians.

CONFLICT OF INTEREST

This work involved no conflict of interest.

PEER REVIEW

The peer review history for this article is available at https://publons.com/publon/10.1111/jcal.12753.

DATA AVAILABILITY STATEMENT

Data can be requested from the first author

ETHICS STATEMENT

The study follows research ethics while collecting the data by inviting the participants to participate voluntarily through an online survey, and that those who do not to participants were simply asked not to fill out the questionnaire. Participants were provided with the details about the questionnaire and the study at the beginning of the survey and that by completing the survey they agree to participate.

ORCID

Abdullah Alamer https://orcid.org/0000-0003-4450-0931
Ahmed Al Khateeb https://orcid.org/0000-0003-4196-5338
Lucas M. Jeno https://orcid.org/0000-0003-3160-9313

REFERENCES

Ahmad, K. S., Armarego, J., & Sudweeks, F. (2017). The impact of utilising mobile assisted language learning (MALL) on vocabulary acquisition among migrant women English learners. *Interdisciplinary Journal of e-Skills and Lifelong Learning*, *13*, 37–57. https://doi.org/10.28945/3703

Akkara, S., Anumula, V., & Mallampalli, M. (2020). Impact of WhatsApp interaction on improving L2 speaking skills. *International Journal of Emerging Technologies in Learning*, *15*(3), 250–259 https://www.learntechlib.org/p/217018/

Alamer, A. (2015). The role of EFL learners' motivation in mobile language learning. First international conference on theory and practice, Asia Pacific Institute of Advanced Research (APIAR), *12*.

Alamer, A. (2021). Construct validation of self-determination theory in second language scale (SDT-L2): The bifactor-exploratory structural

equation modeling (ESEM) approach. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.732016

Alamer, A. (2022a). Basic psychological needs, motivational orientations, effort, and vocabulary knowledge: A comprehensive model. *Studies in Second Language Acquisition*, *44*(1), 164–184. https://doi.org/10.1017/S0272263121000005X

Alamer, A. (2022b). Basic psychological need satisfaction and continued language learning during a pandemic: A structural equation modelling approach. *Journal for the Psychology of Language Learning.*, *4*(1), 1–16. https://doi.org/10.52598/jpll/4/1/1

Alamer, A. (2022c). Exploratory structural equation modeling (ESEM) and bifactor ESEM for construct validation purposes: Guidelines and applied example. *Research Methods in Applied Linguistics*, *1*(1), 100005. https://doi.org/10.1016/j.rmal.2022.100005

Alamer, A. (2022d). Having a single language interest autonomously predicts L2 achievement: Addressing the predictive validity of L2 grit. *System*, *108*, 102850. https://doi.org/10.1016/j.system.2022.102850

Alamer, A., & Al Khateeb, A. (2021). Effects of using the WhatsApp application on language learners motivation: A controlled investigation using structural equation modelling. *Computer Assisted Language Learning.*, 1–27. https://doi.org/10.1080/09588221.2021.1903042

Alamer, A., & Almulhim, F. (2021). The interrelation between language anxiety and self-determined motivation; a mixed methods approach. *Frontiers in Education*, *6*, 618655. https://doi.org/10.3389/feduc.2021.618655

Alamer, A., & Alrabai, F. (2022). The causal relationship between learner motivation and language achievement: New dynamic perspective. *Applied Linguistics*. https://doi.org/10.1093/applin/amac035

Alamer, A., & Lee, J. (2019). A motivational process model explaining L2 Saudi students' achievement of English. *System*, *87*, 102133. https://doi.org/10.1016/j.system.2019.102133

Alamer, A., & Lee, J. (2021). Language achievement predicts anxiety and not the other way around: A cross-lagged panel analysis approach. *Language Teaching Research.*, 136216882110336. https://doi.org/10.1177/13621688211033694

Alqasham, F. H. (2018). Exploring Saudi EFL learners' agency towards the use of WhatsApp for English learning at Qassim university. *International Journal of Linguistics*, *10*(6), 10–43. https://doi.org/10.5296/ijl.v10i6.13857

Alshammari, R., Parkes, M., & Adlington, R. (2017). Using WhatsApp in EFL instruction with Saudi Arabian university students. *Arab World English Journal*, *8*(4), 68–84.

Alzubi, A., & Kaur, M. (2018). The impact of social strategies through smartphones on the Saudi learners socio-cultural autonomy in EFL reading context. *International Electronic Journal of Elementary Education*, *11*(1), 31–40. https://doi.org/10.26822/iejee.2018143958

Andujar, A. (2016). Benefits of mobile instant messaging to develop ESL writing. *System*, *62*, 63–76. https://doi.org/10.1016/j.system.2016.07.004

Andujar, A., & Salaberri-Ramiro, M. (2019). Exploring chat-based communication in the EFL class: Computer and mobile environments. *Computer Assisted Language Learning.*, *34*, 434–461. https://doi.org/10.1080/09588221.2019.1614632

Botes, E., Dewaele, J., & Greiff, S. (2020). The foreign language classroom anxiety scale and academic achievement: An overview of the prevailing literature and a meta-analysis. *Journal for the Psychology of Language Learning*, *2*(1), 26–56. https://doi.org/10.1080/2331186X.2016.1264173

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research*, *53*(4), 445–459.

Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (7th ed.). Routledge.

Deci, E., & Ryan, R. (1985). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality*, *19*(2), 109–134.

Dehghan, F., Rezvani, R., & Fazeli, S. (2017). Social networks and their effectiveness in learning foreign language vocabulary: A comparative study using WhatsApp. *CALL-EJ*, *18*(2), 1–13.

Dincer, A., Yeşilyurt, S., Noels, K., & Vargas Lascano, D. (2019). Self-determination and classroom engagement of EFL learners: A mixed-methods study of the self-system model of motivational development. *SAGE Open*, *9*(2), 2158244019853913.

Fauzi, I., & Angkasawati, P. (2019). The use of listening logs through Whatsapp in improving listening comprehension of EFL students. *Journal of Applied Linguistics and Literature*, *4*(1), 13–26. https://doi.org/10.33369/joall.v4i1.6773

García-Gómez, A. (2020). Learning through WhatsApp: Students' beliefs, L2 pragmatic development and interpersonal relationships. *Computer Assisted Language Learning*, *35*, 1310–1328. https://doi.org/10.1080/09588221.2020.1799822

Gardner, R. (2010). *Motivation and second language acquisition: The socio-educational model*. Peter Lang.

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*, 1–9.

Gutiérrez-Colón, M., Gimeno, A., Appel, C., & Joseph, H. (2016). Improving learners' reading skills through instant short messages: A sample study using WhatsApp. In A. Gimeno, M. Levy, F. Blin, & D. Barr (Eds.), *World call sustainability and computer-assisted language learning: Sustainability and computer-assisted language learning* (pp. 266–281). Bloomsbury Academic.

Hair, J., & Alamer, A. (2022). Partial least squares structural equation modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. *Research Methods in Applied Linguistics*, *1*(3), 100027. https://doi.org/10.1016/j.rmal.2022.100027

Han, T., & Keskin, F. (2016). Using a mobile application (WhatsApp) to reduce EFL speaking anxiety. *Gist Education and Learning Research Journal*, *12*, 29–50.

Hazaea, A. N., & Alzubi, A. A. (2016). The effectiveness of using mobile on EFL learners' reading practices in Najran University. *English Language Teaching*, *9*(5), 8. https://doi.org/10.5539/elt.v9n5p8

Jeno, L., Adachi, P., Grytnes, J., Vandvik, V., & Deci, E. (2019). The effects of m-learning on motivation, achievement and well-being: A self-determination theory approach. *British Journal of Educational Technology*, *50*(2), 669–683.

Jeno, L. M., Vandvik, V., Eliassen, S., & Grytnes, J.-A. (2019). Testing the novelty effect of an m-learning tool on internalization and achievement: A self-determination theory approach. *Computers & Education*, *128*, 398–413. https://doi.org/10.1016/j.compedu.2018.10.008

Karapanos, E., Teixeira, P., & Gouveia, R. (2016). Need fulfillment and experiences on social media: A case on Facebook and WhatsApp. *Computers in Human Behavior*, *55*, 888–897.

Kartal, G. (2019). What's up with WhatsApp? A critical analysis of mobile instant messaging research in language learning. *International Journal of Contemporary Educational Research*, *6*(2), 352–365.

Keezhatta, M. S., & Omar, A. (2019). Enhancing reading skills for Saudi secondary school students through mobile assisted language learning (MALL): An experimental study. *International Journal of English Linguistics*, *9*(1), 437.

Kheryadi, K. (2018). The implementation of "WHATSAPP" as a media of English language teaching. *Loquen: English Studies Journal*, *10*(2), 1–14. https://doi.org/10.32678/loquen.v10i2.685

Lave, J., & Wenger, E. (1991). Legitimate peripheral participation in communities of practice. Situated learning. In *Legitimate peripheral participation*. Cambridge University Press.

Liu, P. (2016). Mobile English vocabulary learning based on concept mapping strategy. *Language Learning & Technology*, *20*(1), 128–140.

MacIntyre, P., & Gregersen, T. (2012). Affect: The role of language anxiety and other emotions in language learning. In *Psychology for language learning* (pp. 103–118). Palgrave Macmillan.

McEown, M., Noels, K., & Chaffee, K. (2014). At the interface of the socio-educational model, self-determination theory and the L2 motivational self system models. *The Impact of Self-concept on Language Learning*, *19*, 50.

Noels, K. (2013). Learning Japanese; learning English: Promoting motivation through autonomy, competence and relatedness. In *Foreign language motivation* (pp. 15–34). Multilingual Matters.

Noels, K., Clément, R., & Pelletier, L. (1999). Perceptions of teachers' communicative style and students' intrinsic and extrinsic motivation. *The Modern Language Journal*, *83*(1), 23–34.

Noels, K., Lou, N., Lascano, D., Chaffee, K., Dincer, A., Zhang, Y., & Zhang, X. (2019). Self-determination and motivated engagement in language learning. In M. Lamb, K. Csizér, A. Henry, & S. Ryan (Eds.), *The Palgrave handbook of motivation for language learning* (pp. 95–115). Palgrave Macmillan.

Oga-Baldwin, W., Nakata, Y., Parker, P., & Ryan, R. (2017). Motivating young language learners: A longitudinal model of self-determined motivation in elementary school foreign language classes. *Contemporary Educational Psychology*, *49*, 140–150.

Önal, N., Çevik, K., & Şenol, V. (2019). The effect of SOS table learning environment on mobile learning tools acceptance, motivation and mobile learning attitude in English language learning. *Interactive Learning Environments*, *30*, 1–14. https://doi.org/10.1080/10494820.2019.1690529

Pike, G., Kuh, G., & McCormick, A. (2011). An investigation of the contingent relationships between learning community participation and student engagement. *Research in Higher Education*, *52*(3), 300–322. https://doi.org/10.1007/s11162-010-9192-1

Plonsky, L., & Oswald, F. (2014). How big is "big"? Interpreting effect sizes in L2 research. *Language Learning*, *64*(4), 878–912. https://doi.org/10.1111/lang.12079

Ryan, R., & Deci, E. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. The Guilford Press.

Ryan, R., & Deci, E. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *101860*, 101860.

Shadiev, R., Liu, T., & Hwang, W. Y. (2020). Review of research on mobile-assisted language learning in familiar, authentic environments. *British Journal of Educational Technology*, *51*(3), 709–720.

Shamsi, A. F., Altaha, S., & Gilanlioglu, I. (2019). The role of m-learning in decreasing speaking anxiety for EFL learners. *International Journal of Linguistics, Literature and Translation*, *2*(1), 276–282. https://doi.org/10.32996/ijllt.2019.2.1.34

Sparks, R., & Alamer, A. (2022). Long-term impacts of L1 language skills on L2 anxiety: The mediating role of language aptitude and L2 achievement. *Language Teaching Research.*, 136216882211043. https://doi.org/10.1177/13621688221104392

Stockwell, G., & Reinders, H. (2019). Technology, motivation and autonomy, and teacher psychology in language learning: Exploring the myths and possibilities. *Annual Review of Applied Linguistics*, *39*, 40–51.

Tragant, E., Pinyana, À., Mackay, J., & Andria, M. (2021). Extending language learning beyond the EFL classroom through WhatsApp. *Computer Assisted Language Learning.*, 1–30. https://doi.org/10.1080/09588221.2020.1854310

Ushioda, E. (2009). A person-in-context relational view of emergent motivation, self and identity. In Z. Dörnyei & E. Ushioda (Eds.), *Motivation, language identity and the L2 self* (pp. 215–228). Multilingual Matters.

Walker, A., & White, G. (2013). *Technology enhanced language learning: Connecting theory and practice*. Oxford University Press.

Wang, Y. (2017). Integrating self-paced mobile learning into language instruction: Impact on reading comprehension and learner satisfaction. *Interactive Learning Environments*, *25*(3), 397–411. https://doi.org/10.1080/10494820.2015.1131170

Weissheimer, J., Caldas, V., & Marques, F. (2018). Using WhatsApp to develop L2 oral production. *Leitura*, *1*(60), 21–38.

Wrigglesworth, J. (2020). Using smartphones to extend interaction beyond the EFL classroom. *Computer Assisted Language Learning*, *33*(4), 413–434. https://doi.org/10.1080/09588221.2019.1569067

How to cite this article: Alamer, A., Al Khateeb, A., & Jeno, L. M. (2022). Using WhatsApp increases language students' self-motivation and achievement, and decreases learning anxiety: A self-determination theory approach. *Journal of Computer Assisted Learning*, 1–15. https://doi.org/10.1111/jcal.12753

APPENDIX A

The learning tasks comprised of listening to podcasts and reading handouts, followed by answering key questions. Those tasks encompassed the following 10 topics:

1. Topic and task 1: Listening to a podcast to answer questions about the growth in artificial plastic
2. Topic and task 2: Reading a handout to answer questions about learners' motivation
3. Topic and task 3: Listening to a podcast to answer questions about evolution and anxiety
4. Topic and task 4: Reading a handout to answer questions about the impact of thoughts on life
5. Topic and task 5: Listening to a podcast to answer questions about merits and demerits of the web/internet
6. Topic and task 6: Reading a handout to answer questions about positive changes in thoughts
7. Topic and task 7: Listening to a podcast to answer questions about the rise of emoji and their uses
8. Topic and task 8: Reading a handout to answer questions about positive lifestyles
9. Topic and task 9: Listening to a podcast on self-help to answer questions about self-help
10. Topic and task 10: Reading a handout to answer questions about foreign language learning

APPENDIX B

TABLE B1 Basic psychological needs of second language scale (BPN-L2)

Item
Autonomy
I am able to freely decide my own pace of learning in English
I am able to freely choose the tasks to be done while learning English
My English teacher allows my class to choose how we approach English learning
My English teacher lets me freely practise English in the classroom
Competence
I feel I am capable of learning English
I can be a successful language learner
I am competent enough to meet the challenges and tasks posed in English learning
I feel a sense of accomplishment in my English classes
Relatedness
My English teacher is friendly and cordial with me
My English teacher is very understanding (puts him/herself in other people's place) about students' problems
My classmates are willing to help and cooperate with me while learning the language
My English teacher cares about my progress

Note: BPN-L2 (Alamer, 2022a).

TABLE B2 Self-determination theory of second language scale. Why are you learning English?

Item
Autonomous motivation
Intrinsic orientation
Because I enjoy learning English
Because of the pleasure I get when I listen to and read English
For the satisfaction I feel when I speak and write in English
For the enjoyment I experience when I achieve a new goal in English learning
Because learning English is a fun activity in and of itself
Identified orientation
Because learning English is important for my personal growth
Because learning English can open up new opportunities and possibilities for me
For the value it holds in my self-development
Because learning English is important to my current and future studies
Because learning English allows me to read and listen to English-based materials that are necessary for my personal success
Controlled motivation
Introjected orientation
Because I would feel guilty if I did not understand English
Because I would feel ashamed if I was not successful at learning English like my friend(s)/family
Because people around me (teacher/peers/parents) expect me to learn English
Because people around me (teacher/peers/parents) would think I'm a failure if I did not speak English
Because I feel pressured by the people around me (teacher/peers/parents) to learn English
External orientation
Because I want to get a prestigious job that requires English proficiency
Because I want to get better marks in the English course
Because English is just a required course that I want to pass
Because I do not want to fail the final exam in the English course
Because there will be negative consequences if I fail to learn English

Note: SDT-L2 (Alamer, 2022a).

TABLE B3 Anxiety subscale

Positively keyed items
I never feel quite sure of myself when I am speaking in our English class
It embarrasses me to volunteer answers in our English class
It worries me that other students in my class seem to speak English better than I do
I get nervous and confused when I am speaking in my English class
I am sometimes afraid the other students will laugh at me when I speak English Negatively keyed items
I do not usually get anxious when I have to respond to a question in my English class
I feel confident when asked to participate in my English class
I do not get anxious when I am asked for information in my English class
I do not understand why other students feel nervous about using English in class
Students who claim they get nervous in English class are just making excuses

Note: Gardner, 2010.