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Autonomous Language Learning with Mobile Technology: A Critical Review of Literature

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ABSTRACT

This article presents a critical literature review of studies on autonomous language learning (ALL) using mobile technology, published between 2014 and 2024. A total of 25 SCOPUS-indexed articles were selected based on predetermined inclusion criteria, which included a focus on language learning and mobile technology, empirical study design, and availability of the full text. Content analysis and thematic analysis were conducted to identify common research trends, designs, and findings. The review shows that most studies examined the effects of ALL, followed by investigations into learners' perceptions. Qualitative methods such as interviews, observations, and reflections were the most frequently applied. Overall, learners expressed positive attitudes towards ALL, although some concerns were noted, and most studies reported benefits for both academic performance and psychological well-being. These findings highlight the need for future research to employ more diverse methodological approaches, explore underrepresented language learning contexts, and examine long-term impacts to better inform effective pedagogical practices in ALL.

1. Introduction

Autonomy is widely recognized as one of the main objectives of education and is practically crucial for the development of lifelong learning in today's learning society [1]. Learner autonomy is increasingly emphasized in language learning and the development of language skills, with the facilitation of varying technology. For instance, Zenouzagh *et al.,* [2] explored learner autonomy, engagement, and satisfaction in a computer-mediated writing environment. Shen *et al.,* [3] investigated the impact of peer assessment on learner autonomy in Chinese college English writing classes, suggesting the superiority of peer assessment over teacher assessment on promoting learner

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autonomy. Zakian *et al.,* [4] studied the effectiveness of vocabulary learning using mobile apps outside classroom.

Technology plays a key role in facilitating autonomous language learning (ALL). Unrestricted access to language learning materials and unlimited language practice opportunities are provided by technology, thus providing learners freedom and choice needed in autonomous learning [5]. Various technologies have been applied in ALL, including paper-based material [6], computer [2,7], online videos [8], etc. Among different technologies, mobile technology is particularly crucial in ALL. Mobile technology-mediated language learning is found to significantly improve learners' achievement and autonomy [9]. Research on ALL using mobile technology is also emerging rapidly. Rashid and Howard [10] explored blogging with smartphones for independent writing practice and found improvement in learners' confidence and motivation. Li and Kim [11] studied the learners' perception and usage of automated feedback systems in language learning applications. Jeong [12] investigated students' self-directed learning experience using mobile applications. ALL with mobile technology seem to contribute to both learners' academic performance and psychological wellness.

While there are many existing studies towards ALL with mobile technology, a review on ALL using mobile technology is still missing. Prevalent literature review is either about mobile-assisted language learning (MALL) or ALL. Therefore, this article aims to conduct a review towards ALL using mobile technology, investigating the research trend, research methods and research results in exiting articles.

2. Literature Review

2.1 Autonomous Language Learning

Learner autonomy has a long history in language learning. The notion of autonomy first appeared around language learning in 1971 through the Council of Europe's Modern Languages [13]. The key of learner autonomy centres around the controllability of learner over the learning process. Autonomy is defined as "a natural result from self-directed learning, during which learner set the objective, go through learning process and evaluation on their own [13]. Similarly, Little [14] suggested language learner autonomy to be "a teaching/learning dynamic in which learners plan, implement, monitor and evaluate their own learning".

Different methods and technologies have been used to facilitate ALL. Benson [13] divided the methods to foster language learner autonomy into 6 categories- resource-based, technology-based, learner-based, classroom-based, curriculum-based and teacher-based, which are usually implemented with one another. Technology has been used frequently to enhance language learner autonomy. Among varying technologies, mobile technology has a close relationship with ALL. As it provides rich resources and enables learner to learn anytime anywhere, it is an ideal tool for ALL where learners take control of their learning. Despite the popularity of mobile technology, research towards its application in ALL is still limited. Existing studies mainly use paper-based material or computers to assist ALL. Derinalp *et al.,* [15] investigated the impact of online learning towards learner autonomy. Aladini *et al.*, [16] investigated self-directed writing development through computer- and AI-based tasks. Girón-García [17] studied the use of online tasks and online dictionary in facilitating ALL in classroom. Selvaraj *et al.,* [7] studied ALL in computer-assisted language learning environment through Transactional Distance Theory.

However, studies on ALL applied mobile technology are also emerging. For instance, Deng and Wang [18] studied the impact of mobile network-based English writing teaching on students' autonomous learning abilities. Messaging apps like WhatsApp [19]. have also been applied in ALL. Considering the wide usage of mobile technology, discovering its usage in ALL is essential.

2.2 Mobile Technology in Autonomous Language Learning

The development of mobile technology both facilitates ALL and requires more learner autonomy. Mobile devices decentralize the teacher in the teaching process as learners now can access information inside and outside the classroom, which shifts the roles of both teachers and learners, requiring teachers to cede control and learners to take greater responsibility for their own learning [20]. There is a substantial amount of research in the use of mobile technology in language learning. The research in MALL takes a distinctive approach - some research studies the usage of mobile technology in classroom or under guidelines, while others study mobile learning outside classroom where learners take control of the learning process.

There are MALL research where learners have limited autonomy. For example, participants were required to use mobile devices in project-based learning for designing presentation and poster [21]. In a study on video dubbing app, participants are to complete dubbing tasks corresponding to textbook units [22]. In addition, in a study about digital flashcards, participants were required to memorize a fixed set of 100 words [23]. Similarly, Sato *et al.,* [24] examined vocabulary recall using mobile devices, again with a required set of 100 expressions. In these studies, learners use mobile technology mainly following teachers' instruction.

While in some MALL research, learners mainly use the mobile devices for autonomous learning outside classroom. In a study on language learning experience using Duolingo, students were to choose which language to study [25]. Messaging apps like WhatsApp and WeChat are also investigated. Ebrahimi [26] discovered the positive correlation between students' frequency of WhatsApp use and their improvement in writing skills. WhatsApp was also found to impact language learners' motivation [27] and improve learner vocabulary [28]. This type of MALL research reflects the trend of mobile learning which increasingly emphasizes learner autonomy. Considering the distinct setting in this kind of MALL research, it's essential to conduct a review that focuses on ALL with mobile technology.

2.3 Previous Literature Review on ALL with Mobile Technology

There are only several literature reviews on ALL. Chong and Reinders [29] studied the conceptualization and evaluation of learner autonomy. Kalyaniwala and Ciekanski [30] conducted a literature review on language learner autonomy and computer-assisted language learning (CALL). Chang and Sun [31] reviewed the impact of AI on self-regulated language learning. It seems that existing reviews towards ALL studies haven't put their focus on mobile technology. Whereas there are many existing literature reviews on MALL. Some focused generally on research trend [32,33], or the efficiency of MALL [34,35]. Some focus on specific language skills, like speaking [36,37] and writing [38]. Yet few of them delved into learner autonomy. Martinez *et al.,* [35]'s review on MALL highlighted the potential of MALL to promote learner autonomy. In Ounissi *et al.,* [39]'s review about online extensive reading, it's pointed out that online extensive reading significantly improves learners' engagement and autonomy. Similarly, Weng *et al.,* [37] suggested the effectiveness of mobile-assisted peer feedback closely relates with increased learner autonomy. These reviews show the key role autonomy plays in MALL and need for further investigation.

Overall, literature review on ALL with mobile technology remains absent. Therefore, this article aims to conduct a critical review on ALL with mobile technology, finding out the research trends, research designs and research results in existing studies.

3. Research Questions

This study aims to answer the following research questions:

1. What are the research trends including research purpose, learning context, usage of mobile applications in studies on ALL with mobile technology?
2. What are the research designs in studies on ALL with mobile technology?
3. What are learners' perceptions towards ALL with mobile technology?
4. What are the effects ALL with mobile technology?

4. Research Method

This study adopted a qualitative research approach to conduct a comprehensive critical review of ALL with mobile technology. The steps for conducting the critical review followed Kitchenham's [40] systematic review methodology: search articles, study selection, data extraction and synthesis.

4.1 Search Articles

First, studies were searched through SCOPUS database. The search terms included the keywords "autonomous language learning" or "language learner autonomy" with "mobile technology". The year of publication was limited to 2014 to 2024. The document type was limited to article, and the language is limited to English. Overall, 63 studies were found.

4.2 Study Selection

The study inclusion criteria are as follows:

a) The study focuses on language learning.
b) The study uses mainly mobile technology.
c) The study is an empirical study.
d) The study is accessible.

After screening the title and abstract, 25 studies were included. 38 studies were excluded from the initial pool of 63 articles. The reasons for exclusion are as follows:

a) 24 studies aren't focusing on mainly language learning, but rather the development of mobile technology.
b) 2 studies use technologies other than mobile technology, like computers or websites.
c) 6 studies are not empirical research but reviews.
d) 6 studies are not accessible.

4.3 Data Extraction and Synthesis

Content analysis based on Hsieh and Shannon [41] and thematic analysis based on Thomas and Harden [42] were used in sorting and analysing the data. Content analysis was used to identify common research trends, research methods and learner perception in studies. Thematic analysis was used to identify the impact of ALL with mobile technology. The thematic synthesis method includes three stages: line-by-line coding, development of descriptive themes, and generation of analytical themes.

5. Results

5.1 Research Trends in Studies on ALL with Mobile Technology

5.1.1 Distribution of research purposes

Table 1 shows the details of studies on three research purposes and Figure 1 is a bar graph displaying the distribution of research purposes by year. Three research purposes are identified from 25 studies - understanding learners' perception towards ALL with mobile technology, promoting autonomy through mobile learning, and evaluating the impact of ALL with mobile technology. The first purpose includes 9 studies, accounting for 36% of the total. The second purpose includes 4 studies, accounting only for 16%. The third purpose includes 12 studies, 48% of the total, ranking the top. The most researched purpose is evaluating the impact of mobile learning, followed by understanding learners' perception, while promoting learner autonomy receives less attention.

Figure 1 shows the distribution of research purpose in studies on ALL with mobile technology from 2014 to 2024. Before 2016, there had been no studies published regarding ALL with mobile technology. After 2020, the number of studies increased rapidly, 2022 being the year with the most published studies. Overall, studies about learners' perception and impact of ALL with mobile technology have rapidly increased, while studies focusing on learner autonomy remained rare.

Table 1
Research purposes of studies on ALL with mobile technology

No.	Research Purpose	Author (Year)	Number	Percentage
1	Understanding learners' perception towards ALL with mobile technology	Mullen (2021) [43]; Chen and Zhao (2022) [44]; Muharom *et al*., (2022) [45]; Karaaslan and Kılıç (2019) [46]; He and Li (2023) [47]; Mohamed *et al*., (2024) [48]; Wu *et al*., (2022) [49]; Thuy (2021) [50]; Yang and Lou (2024) [51]	9	36%
2	Promoting learner autonomy through mobile learning	Ardi (2017) [52]; Roh and Kim (2019) [53]; Hazaea and Alzubi (2018) [54]; Pham *et al*., (2021) [55]	4	16%
3	Evaluating the impact of ALL with mobile technology	Jeong (2022) [12]; Zakian *et al*., (2022) [4]; Strong *et al*., (2023) [56]; Zeng and Fisher (2024) [57]; Diari *et al*., (2023) [9]; Al-Shehab (2020) [58]; Noor and Islam (2024) [59]; Li and Kim (2024) [11]; Raj and Tomy (2023) [60]; Fakih (2022) [61]; Janfeshan *et al*., (2023) [28]; Rashid *et al*., (2020) [62]	12	48%

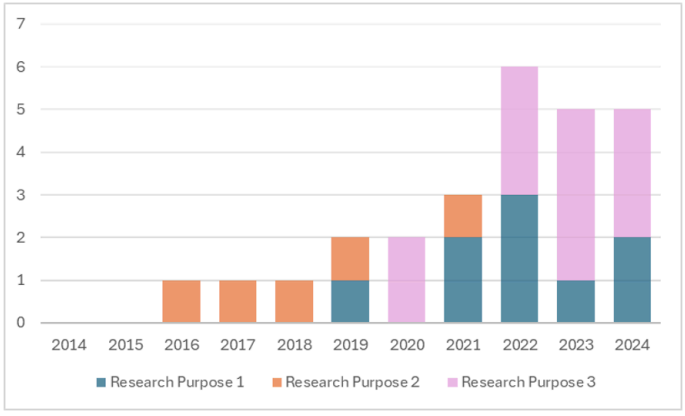

Fig. 1. Distribution of research purposes in studies on ALL with mobile technology

5.1.2 Distribution of language learning context

Figure 2 is a pie chart that shows the distribution of language learning contexts in studies on ALL with mobile technology. Based on their language learning context, the studies are divided into 6 categories: non-specific, vocabulary, reading, writing, listening, speaking. Among 25 articles, 14 articles focused on non-specific learning context, 5 articles on vocabulary, 1 article on reading, 2 articles on writing, 2 articles on listening, and 1 article on speaking. Based on the pie chart, 56% of the studies focused generally on language learning, rather than a specific skill. The second most focused area is vocabulary, with 20% of articles delving into this context. As for the four language skills, only 1-2 articles are concerned.

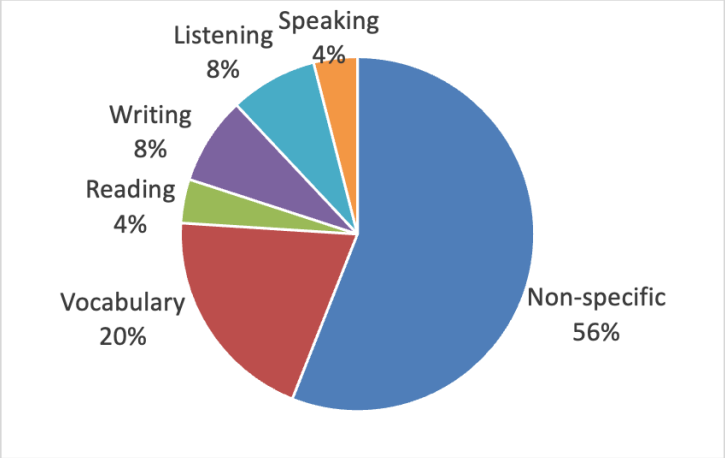

Fig. 2. Distribution of language learning contexts in studies on ALL with mobile technology

5.1.3 Usage of mobile technology

Table 2 shows the types of mobile technologies used in studies on ALL with mobile technology. Four types of mobile apps are identified - mobile devices, language learning applications, messaging application and others. General use of mobile devices was most investigated, with 9 out of 25 studies. Language learning applications like Quizlet, Duolingo, English dictionary were also commonly researched, with 9 out of 25 studies. Messaging apps like WhatsApp and WeChat were investigated in 4 studies. Other tools like mobile games, blogs, and Microsoft Word have also been used within 4 studies. Notably, in a study, both language learning application - English dictionary application and other mobile applications - Microsoft Word application, were investigated [58].

Table 2
Types of mobile technologies used in studies on ALL with mobile technology

No.	Type (n)	Mobile technology	Author (Year)
1	Mobile device (9)	Mobile phone	Mullen (2021) [42]; Muharom *et al.*, (2022) [45]
		Mobile application	Karaaslan and Kılıç (2019) [46]; Raj and Tomy (2023) [60]
		Not specified	He and Li (2023) [47]; Strong *et al.*, (2023) [56]; Thuy (2021) [50]; Noor and Islam (2024) [59]; Yang and Lou (2024) [51]
2	Language learning application (9)	Hackers TOEIC	Jeong (2022) [12]
		A digital flashcards application	Zakian *et al.*, (2022) [4]

Table 2 ***(Continued)***

		Gamified Vocabulary Learning Apps	Chen and Zhao (2022) [44]
		Grammar/Spell Checker; Urimal 365	Roh and Kim (2019) [53]
		Quizlet	Mohamed *et al*., (2024) [48]
		Duolingo	Zeng and Fisher (2024) [57]
		The Belajar Bahasa Bali application	Diari, *et al*., (2023) [9]
		An English dictionary application	Al-Shehab (2020) [58]
		Automated feedback systems	Li and Kim (2024) [11]
3	Messaging application (4)	WhatsApp	Hazaea and Alzubi (2018) [54]; Janfeshan *et al*., (2023) [28]
		WeChat	Wu *et al*., (2022) [49]
		Not specified	Fakih (2022) [61]
4	Others (4)	Schoology m-learning platform	Ardi (2017) [52]
		Internet search engines	Hazaea and Alzubi (2018) [54]
		Mobile games	Pham *et al*., (2021) [55]
		Microsoft Word application	Al-Shehab (2020) [58]

5.2 Research Methods in Studies on ALL with Mobile Technology

5.2.1 distribution of research methods and instruments

Table 3 shows the research method and instruments used in studies on ALL with mobile technology. As this critical review focuses on empirical research, the research methods can be generally divided into three categories: qualitative and quantitative and mixed method. Then the instruments are also listed. The research methods are categorized by research purpose. For 9 studies in research purpose 1, 7 of them used qualitative methods, while 2 of them used mixed methods.

Table 3
Research methods and instruments used in studies on ALL with mobile technology

No.	Research purpose	Research method (n)	Instrument (n)
1	Understanding learners' perception	Qualitative (7) Mixed (2)	Survey & questionnaire (7) Interview (6) Case study (1) Reflection (1) Chat transcript (1) Observation (1)
2	Promoting learner autonomy through mobile learning	Qualitative (3) Quantitative (1)	Survey (2) Interview (2) Group chat (1) Test (1) Reflection（1） e-portfolios (1) Personal message (1) Online record (1)
3	Evaluating the impact of ALL with mobile technology	Qualitative (2) Quantitative (4) Mixed (6)	Survey & questionnaire (9) Interview (6) Test (6) Observation (2) Writing performance rating (1) Learning journal (1) e-portfolios (1) Blogpost (1) Written feedback (1)

The most used instruments are survey and questionnaire, followed by interview, while case study, reflection form, chat transcript are used once each. For 4 studies in research purpose 2, 3 used qualitative method, and 1 used quantitative method. The instruments used are diverse, while surveys and interviews are used most. As for 12 articles in research purpose 3, 2 used qualitative method, 4 used quantitative method, and 6 used mixed method. The commonly used research instruments include survey, questionnaire, test and interview. Other instruments used include case study, reflection, chat transcript, e-portfolios, personal message, online record, observation, writing performance rating, learning journal, blogpost and written feedback.

Overall, for studies with research purposes 1 and 2, qualitative methods were commonly adopted. For studies with research purpose 3, mixed methods were used more often. For all three research purposes, instruments including surveys, questionnaires and interviews were used most often.

5.2.2 Distribution of instruments measuring autonomy

Table 4 shows the instruments measuring autonomy in studies on ALL with mobile technology. Among 25 articles, only 11 articles measured learner autonomy. Among the 11 articles, 3 types of instruments were used to measure autonomy: existing questionnaires; survey items from other research; others. Overall, self-developed interviews were used most frequently. The Learner Autonomy Questionnaire [63] was used twice, and the learner Autonomy Scale [64] was used once. Two researchers use adopted surveys from other studies. Other than survey and questionnaire, interview, personal messages, online records, students' portfolio, WhatsApp group chat, classroom observations, blogposts have also been used to measure autonomy. The diversity in research methods and tools is likely due to the nature of autonomy, which can be difficult to measure.

Table 4
Instruments used to measure autonomy in studies on ALL with mobile technology

No.	Type (n)	Author (Year)	Instruments
1	Existing questionnaire (3)	Pham *et al*., (2021) [55]	the Learner Autonomy Scale [64]
		Fakih (2022) [61]	the Learner Autonomy Questionnaire [63]
		Janfeshan *et al*., (2023) [28]	the Learner Autonomy Questionnaire [63]
2	Survey items adapted from other research (2)	Yang and Lou (2024) [51]	Four survey items adopted from Baard *et al.*, [65] and Nikou and Economides [66]
		He and Li (2023) [47]	three survey items adopted from Kreijns *et al.*, [67]
3	Others (5)	Ardi (2017) [52]	reflections, personal messages, online records
		Hazaea and Alzubi (2018) [54]	interview, students' portfolio, WhatsApp group chat
		Zeng and Fisher (2024) [57]	interview
		Noor and Islam (2024) [59]	Interview, classroom observations
		Diari *et al*., (2023) [9]	survey
		Rashid *et al*., (2020) [62]	blogposts

5.3 Learner's Perception towards ALL with Mobile Technology

Table 4 displays learner's perception towards ALL with mobile technology. Among 9 studies on learner perception towards ALL with mobile technology, each study dive into different aspects of learners' perception. Notably, 4 studies used Self-determination Theory and Technology Acceptance Model to study psychological factors influencing the use of mobile technology including learners' motivation, acceptance, intention to use, attitudes, etc. Challenges and limitations of ALL with mobile technology are also highlighted in several studies. Mullen [49] suggested smartphones play a limited role in participants learning habits. Mohamed [50] emphasized the importance of balancing MALL with diverse teaching methods to avoid monotony. Social interactions were also emphasized [51,52]. Similarly, Wu *et al.,* [53] pointed out students need more teacher support. Overall, positive attitude and worries towards ALL with mobile technology coexisted.

Table 5
Learner's perception towards ALL with mobile technology

No.	Author (Year)	Perception	Theory
1	Mullen (2021) [43]	Limitations	-
2	Chen and Zhao (2022) [44]	Motivation and acceptance	Self-Determination Theory; Technology Acceptance Model
3	Muharom *et al*., (2022) [45]	Learning experience	-
4	Karaaslan and Kılıç (2019) [46]	student characteristics	-
5	He and Li (2023) [47]	Intention to use	Self-Determination Theory; Technology Acceptance Model
6	Mohamed *et al*., (2024) [48]	positive attitudes	Technology Acceptance Model
7	Wu *et al*., (2022) [49]	Challenges	-
8	Thuy (2021) [50]	Positive attitude	-
9	Yang and Lou (2024) [51]	psychological factors	Self-Determination Theory; Technology Acceptance Model

5.4 The Effects of ALL with Mobile Technology

Table 6 shows the thematic analysis of the effects of ALL with mobile technology and Table 7 provides a summary of the themes and codes identified. studies with research purpose 3- evaluating the impact of ALL with mobile technology are analysed here. The excerpts are research results identified in the abstract or conclusion of each article. Overall, three themes were identified, which are (1) Positive improvement in language skills; (2) Neutral effect on language skills; (3) Positive improvement in psychological aspects. For theme 1, four codes are identified including improved language proficiency, Increased vocabulary, improved writing skills, Improved speaking skills, improved listening skills. For theme 2, only one code is included: no significant improvement in listening and reading. Theme 3 includes 5 codes: increased motivation, improved autonomy; improved engagement, increased confidence and reduced anxiety. Overall, most researchers have found a positive impact of ALL with mobile technology on learners' language skills, particularly vocabulary. Improved learner autonomy is also frequently reported in studies on ALL with mobile technology. Furthermore, autonomy appears to be closely linked with other psychological factors such as motivation, engagement, confidence, and anxiety.

Table 6
Thematic analysis of the effects of ALL with mobile technology

No.	Author (Year)	Themes	Codes	Excerpts
1	Jeong (2022) [12]	Positive improvement in psychological aspects; Neutral effect on language skills	Increased motivation ; no significant improvement in listening and reading	"The results show that incorporation of mobile applications into language learning could foster learner motivation and make their learning more sustainable and entertaining than simply using the conventional instructional methods" "…, there was a significant average improvement in the TOEIC listening ability, and there was an average increase in the TOEIC reading part scores, although there was no significant difference seen."
2	Zakian *et al*., (2022) [4]	Positive improvement in language skills	Increased vocabulary	"The results revealed that the use of mobile applications contributed significantly to vocabulary knowledge development"
3	Strong *et al*., (2023) [56]	Positive improvement in psychological aspects	Improved engagement	"Successful student engagement was tracked in forms of videos watching; lines from the videos, spoken aloud, and vocabulary items studied; suggesting a promising technology for language learning"
4	Zeng and Fisher (2024) [57]	Positive improvement in psychological aspects	Increased motivation	"Learners' activity-specific intrinsic motivation (IM) for using Duolingo and their underlying psychological need for autonomy and competence can be transferred to a more general level, thereby enhancing learners' global IM for L2."
5	Diari *et al*., (2023) [9]	Positive improvement in language skills; Positive improvement in psychological aspects	Improved language proficiency; Improved autonomy	The findings of this study contribute to the literature on MTMLL and local language learning by highlighting the importance of technology in promoting learners' achievement and autonomy.
6	Al-Shehab (2020) [58]	Positive improvement in language skills; Positive improvement in psychological aspects	Improved writing skills; improved autonomy	"The findings of this research imply a positive effect of the mobile-assisted language learning approach on student writing skills"; "Overall, results suggest that learner autonomy is improved by engaging in the writing process both inside and outside of the classroom."
7	Noor and Islam (2024) [59]	Positive improvement in psychological aspects	Increased Confidence; reduced anxiety; improved autonomy	"Participants reported increased confidence and reduced anxiety when engaging in classroom activities, alongside enhanced autonomy through the ability to customize their learning pace. "
8	Li and Kim (2024) [11]	Positive improvement in psychological aspects	Increased Confidence;	"Results highlight positive perceptions and successful use of AFSs, with students leveraging these tools to identify improvement areas, track progress and gain confidence. "
9	Raj and Tomy (2023) [61]	Positive improvement in language skills	Improved listening skills	"The M-learning method has improved listening skills among the groups."

Table 6 ***(Continued)***

10	Fakih (2022) [61]	Positive improvement in psychological aspects		were enhanced to a great deal. Finally, the students expressed satisfaction in terms of their autonomy ratings and complementary points of view on the use of SMS."
11	Janfeshan *et al*., (2023) [28]	Positive improvement in language skills; Positive improvement in psychological aspects	Increased Vocabulary; Improved autonomy	"Compared to face-to-face instruction, the findings demonstrated that using WhatsApp greatly enhanced learners' vocabulary learning. Furthermore, for most participants, using WhatsApp as a learning tool enhanced their autonomy, which was a pleasant experience."
12	Rashid *et al*., (2020) [62]	Positive improvement in language skills	Improved writing skills	"The study found that the combined learner-training model used was successful in motivating and enabling the students to create blogs on their smartphones to practice their English writing skills."

Table 7
Overview of themes and codes

No	Themes	Codes (n)
1	Positive improvement in language skills	Improved language proficiency (2) Increased vocabulary (2) Improved writing skills (2) Improved listening skills (1)
2	Neutral effect on language skills	No significant improvement in listening and reading (1)
3	Positive improvement in psychological aspects	Increased Motivation (2); Improved autonomy (5) Improved engagement (1) Increased confidence (2) Reduced anxiety (1)

6. Discussion

Existing studies have mainly focused on evaluating the impact of ALL with mobile technology, followed by understanding learners' perception, while promoting learner autonomy receive less attention. Similarly, a literature review in mobile learning found most mobile learning studies focus on effectiveness [32]. Learners' perception is also found to be a popular topic in MALL reviews [68]. The specific focus on learner autonomy seems to be lacking in existing research, corresponding to previous research that the theory and practice of autonomy in education have remained largely apart [1]. Based on the bar graph (see Figure 1), the combination of ALL with mobile technology seems to be a new field that only raises attention after 2018. This corresponds to previous review on ALL that online applications such as social media and other applications seem to be favoured increasingly compared to CALL tools [30].

For the language learning context, most studies didn't have a specific focus, but rather on general language learning, followed by vocabulary. Few studies investigated a specific language skill. As for the mobile technologies applied in ALL, general use of mobile devices and language learning applications were commonly investigated, followed by messaging apps.

Qualitative methods were commonly used when investigating learners' perception and promoting learner autonomy, while mixed methods were used more when evaluating the impact of ALL with mobile technology. Commonly used instruments included surveys, questionnaires and interviews. This phenomenon is likely due to the nature of autonomy, which has a rich amount of

conceptualization. This article expands on previous research about tools to measure learner autonomy [29]. Three types of instruments were used to measure autonomy including existing questionnaires, adapted survey items and other tools like interview, observation, online records, etc. In addition, instruments used to measure effectiveness like chat transcript, e-portfolios, personal message, online record, blogpost also make use of mobile technologies, showing that mobile technology can not only be used as a learning tool, but also a way to record and monitor the learning process.

Other than effectiveness, studies towards learner perception accounted for a large part in ALL with mobile technology research. While existing reviews on MALL [35,36] and web-based learning [39] found only positive attitudes and perception in learners, learners' perception towards ALL with mobile technology were rather mixed. Researchers emphasized the importance of teacher support [49], social interaction [46,51], diverse teaching methods [48] in ALL with mobile technology, suggesting that learners, especially low achievers may not be fully ready for ALL.

Through thematic analysis, most studies found that ALL with mobile technology bring positive changes in learners' language skills and psychological aspects, while one study found no significant improvement in learners' listening and reading skills [12].

7. Conclusion

This review reveals that research on autonomous language learning (ALL) using mobile technology has expanded in recent years, with most studies focusing on evaluating its effectiveness and exploring learner perceptions. While the evidence generally points to positive impacts on language development, learner autonomy, and psychological well-being, notable gaps remain. In terms of research trends, studies specifically aimed at promoting learner autonomy and developing particular language skills are still scarce. Future research could focus on enhancing autonomy and targeting skills such as reading and speaking, which have received less attention. For the design of mobile-based ALL environments, pedagogical approaches such as situated learning theory and intrinsic motivation could be applied to strengthen students' learning autonomy, and the insights gained could inform the development of a mobile-based learning framework.

In relation to the use of mobile technologies, there is potential to explore tools beyond common language learning applications, such as messaging apps, learning platforms, and blogs, to broaden the learning experience. Research design could benefit from greater use of mobile-enabled instruments, including online activity records, student portfolios, and messaging group discussions, which offer new ways of capturing learning processes. The current diversity of tools for measuring autonomy also calls for comparative studies to identify similarities and differences, leading to the development of more standardised instruments.

From the perspective of learner perceptions, findings suggest that students continue to face challenges in autonomous learning and may require structured external support, including teacher facilitation, peer interaction, and targeted guidance. Although most studies report positive effects of ALL on academic performance and psychological wellness, some have found neutral results for listening and reading skills. One possible reason is that these skills often demand high levels of motivation, sustained self-driven effort, and strong learner autonomy, which may not be fully supported in current mobile-based ALL designs. Future research could focus on developing mobile-based ALL environments specifically aimed at enhancing listening and reading, incorporating elements that foster intrinsic motivation and strengthen learner autonomy. Such targeted designs have the potential to achieve a more balanced improvement across all language competencies.

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