Arab World English Journal
INTERNATIONAL PEER REVIEWED JOURNAL ISSN: 2229-9327

Arab World English Journal (AWEJ) Volume 17. Number 3, September 2026 Pp.165-188
DOI: https://dx.doi.org/10.24093/awej/vol17no3.10

AI-Supported Self-Directed Learning and Learner Autonomy among Arab EFL Learners: A Systematic Review (2021–2026)

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Received: 06/04/2026 Accepted:08/21/2026 Published:09/10/2026

Abstract

Arab learners remain underrepresented in the international AI in education literature, and this review aims to address that gap. It examines how AI facilitates personalized and self-directed learning in English as a Foreign Language (EFL) within Arab settings. The review synthesizes empirical evidence on learner autonomy, self-regulation, and metacognitive development to identify the pedagogical, technical, cultural, and institutional factors influencing implementation in Arab classrooms. Following PRISMA 2020 guidelines, 156 empirical articles published between 2021 and 2026 in Q1 or Q2 journals were collected, assessed for quality, and analyzed through narrative synthesis. Results show that conversational agents, intelligent tutoring systems, and adaptive platforms promote autonomy, self-regulation, and metacognitive skills, with notable improvements in writing and speaking. Nonetheless, challenges include over-dependence on AI output, uneven technological infrastructure, limited teacher training, and a disconnect between AI personalization and traditional teacher-centered approaches prevalent in many Arab educational systems. The review concludes that success hinges on pedagogy and cultural appropriateness rather than technology alone. It advocates for blended human–AI models, explicit responsible AI instruction, phased institutional adoption, and culturally tailored tools. Further longitudinal and large-scale research in Arab contexts is essential.

Keywords: Arab learners, artificial intelligence, English as a foreign language, English language education, learner autonomy, personalized learning, self-directed learning

How to cite: Ayesha, A. (2026). AI-Supported Self-Directed Learning and Learner Autonomy among Arab EFL Learners: A Systematic Review (2021–2026). *Arab World English Journal, 17*(3): 165-188. https://dx.doi.org/10.24093/awej/vol17no3.10

Introduction

Few developments have significantly transformed contemporary language teaching as much as the advent of Artificial Intelligence (AI) in English education. AI has shifted from merely automating administrative tasks to supporting personalized learning systems tailored to individual needs, preferences, and proficiency levels (Wei, 2023; Huang & Hwang, 2024). This shift carries particular significance for English as a Foreign Language (EFL) settings, where students often face limited exposure to authentic language, fewer interaction opportunities, and diverse educational backgrounds, requiring differentiated approaches. In the Arab world, where English skills are crucial for academic success, career growth, and international communication, AI-driven personalized learning offers promising opportunities alongside complex challenges that deserve systematic research (Daweli & Mahyoub, 2024). Self-directed learning (SDL)—the ability of learners to independently manage their learning process by choosing resources, strategies, and assessing progress—is vital for effective language acquisition (Aldawsari & Al Fadda, 2023). Knowles (1975) describes SDL as "a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources, selecting and implementing strategies, and evaluating outcomes" (p. 18). Teaching Arabs to develop this skill remains challenging. Studies by Arafat and Al Khshali (2025) and Adnan and Sayadi (2021) show that Arab students often lack motivation for autonomous learning, rely heavily on teachers, possess weak metacognitive skills, rarely use self-regulation techniques, and are reluctant to study independently. Alrabai (2021) attributes these difficulties to systemic issues: large class sizes that hinder individual attention, curricula focused on exams that prioritize memorization over critical thinking, and sociocultural beliefs that see the teacher as the sole authority on knowledge. Typological differences between Arabic and English compound the problem, producing persistent challenges in pronunciation, grammar, vocabulary, and pragmatic competence that hinder independent learning (Jahara & Abdelrady, 2021).

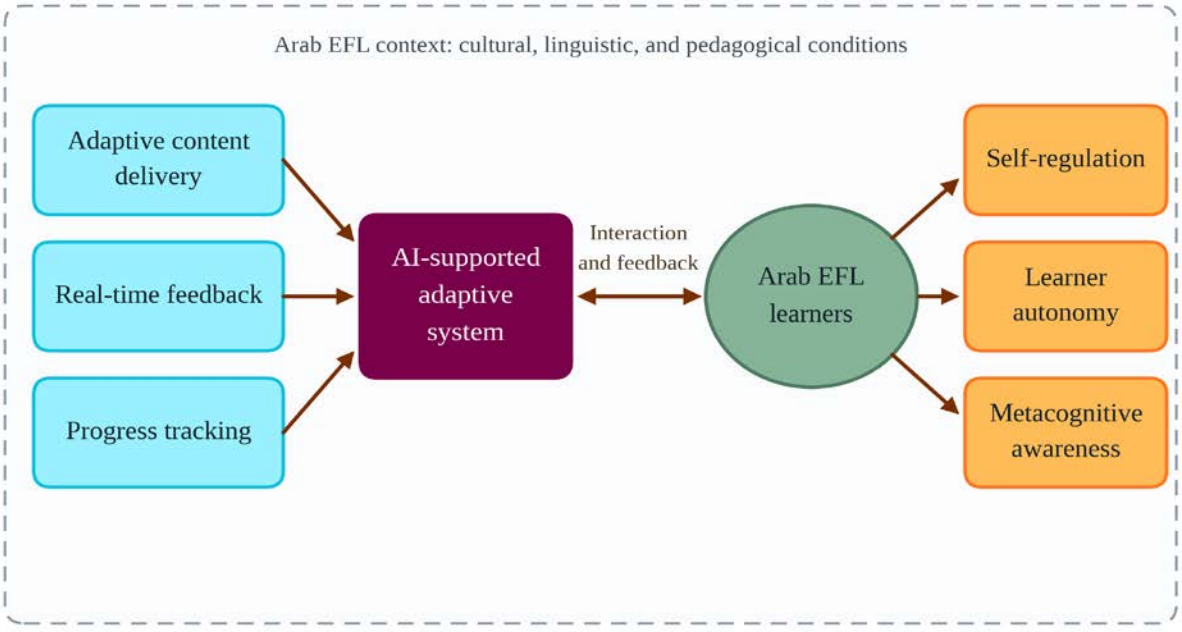


Figure 1. Conceptual framework of AI-supported personalized learning and self-directed learning development among Arab EFL learners

As illustrated in Figure 1, the AI-based personalized learning model operates through an active interaction between adaptive systems and learners within the Arab EFL environment. The framework shows how AI elements like adaptive content delivery, real-time feedback, and progress tracking contribute to an adaptive system that actively engages the learner through reciprocal interaction. It also emphasizes that skills such as self-regulation, learner autonomy, and metacognitive awareness develop within the learner, rather than being directly provided by the system. This dynamic exchange between AI and Arab EFL learners occurs within specific cultural, linguistic, and pedagogical contexts of Arab education, depicted in the figure as the broader environment. Although these contextual factors have seldom been studied extensively, AI-driven educational tools present opportunities to address them by offering adaptive, personalized learning environments that foster self-directed learning skills. Examples include intelligent tutoring systems offering immediate feedback, chatbots for practicing communication, adaptive systems modifying difficulty based on performance, conversational agents enabling practice on demand, and learning analytics dashboards tracking progress (Huang & Hwang, 2024; Feng, 2025). These technologies could shift teacher-dependent models toward environments that promote independent practice, instant formative feedback, personalised instruction, and wider access to resources. Moreover, AI solutions help overcome resource limitations in challenging settings by providing personalized experiences that traditional approaches cannot achieve (Jin et al., 2023).

Research Problem

Although AI tools are increasingly adopted in educational institutions across the Middle East and North Africa, their impact on Arab EFL learners' teaching methods remains unclear. This review highlights a key issue: Arab EFL students traditionally show low readiness for autonomous learning and rely heavily on teachers. Yet, AI technologies are being implemented widely without evidence on whether they promote independence or reinforce passive learning habits. For instance, generative AI like ChatGPT can produce complete texts instantly, potentially encouraging learners to passively consume AI-generated content rather than actively engage with language. The challenge is twofold: institutions are investing in AI without solid evidence of its effect on learner independence, and existing research mostly comes from contexts with pedagogical principles different from those in Arab classrooms.

Research Gap

Although research on AI in language learning has grown rapidly in Western and East Asian contexts, Arab EFL education, with its unique sociocultural, linguistic, pedagogical, and technological factors, has not been equally explored. Three main gaps emerge: First, existing systematic reviews of AI in language education provide overall findings without considering cultural or regional differences, so the influence of teacher-centered educational traditions remains unexamined (Ma et al., 2024; K. C. Li & Wong, 2023). Second, the literature has focused on measurable proficiency outcomes rather than on constructs like autonomy, self-regulation, and metacognition, which are especially vulnerable in cultures with high dependence on teachers. Third, no review has comprehensively summarized evidence since the advent of generative AI tools in late 2022, particularly regarding Arab learners, despite this period drastically changing personalized learning. To effectively utilize AI for Arab students, it is crucial to consider differences between Arabic and English, traditional educational values of memorization and

teacher authority, varying levels of digital literacy, and disparities in technological infrastructure across Arab countries (Pegrum, 2025). This review aims to fill these gaps.

Theoretical Framework

This review is structured around four complementary theoretical perspectives. They are combined because no single framework accounts for the full range of phenomena under examination: AI-supported learning simultaneously involves learner motivation, cognitive self-management, mediated social interaction, and the decision to adopt a technology. Self-determination theory addresses learner motivation and the psychological needs of autonomy, competence, and relatedness. It is used here to interpret findings on motivation and engagement. Metacognitive theory addresses learners' monitoring and regulation of their own cognition, and it organizes the synthesis of evidence on self-regulation, planning, and self-assessment. Sociocultural theory frames AI tools as mediating artefacts that provide scaffolding within a learner's zone of proximal development, and it is used to interpret evidence on the balance between support and independence. Technology acceptance models account for perceptual and contextual variables such as perceived usefulness, perceived ease of use, digital literacy, and institutional support that explain patterns of adoption and resistance. Taken together, the four perspectives provide the analytical categories used to organise the results: motivation and engagement, self-regulation and metacognition, scaffolding and mediation, and acceptance and implementation. Each is applied to a specific subset of the findings rather than invoked in general terms, and the Discussion considers the theoretical implications of the synthesis for each framework.

Purpose and Research Questions

This review synthesises research published between 2021 and 2026 in Q1 and Q2 journals in order to explore what is known about the role of AI technologies in personalised and self-directed learning in English language education, with a particular focus on Arab EFL settings. It offers evidence-based recommendations for integrating these technologies without displacing essential pedagogical processes . this review has three objectives: to synthesize current theoretical and empirical research on AI-supported Personalized Learning and SDL in language education; to critically evaluate the opportunities and challenges that AI technologies offer for enhancing learner agency and self-regulation; and to identify context-specific contextual factors, challenges, and prospects for implementing these technologies in Arab EFL settings. The review covers adaptive learning systems, intelligent tutoring systems, conversational AI, learning analytics, automated feedback and AI-generated content. Since this is a systematic review rather than an experimental study, formal hypotheses are unnecessary; instead, three research questions will guide the synthesis.

RQ1: What is the effect of AI on the self-directed learning skills and learner autonomy of Arab EFL students?

RQ2: What are the potential benefits of AI-assisted personalized learning systems for promoting learner autonomy and learning success in Arab educational settings?

RQ3: What challenges to deep cognitive engagement, authentic interaction, and the development of autonomous learning arise when AI is implemented in Arab EFL contexts?

Literature Review

This section reviews the conceptual and empirical research on AI-supported personalized learning, self-directed learning, learner autonomy, and studies conducted in Arab EFL contexts. The methods for selecting and evaluating these studies are detailed in the Methodology section.

Artificial Intelligence and Personalized Language Learning

Personalized learning using AI depends on algorithmic systems' ability to model each learner's state and adapt instruction accordingly. Bibliometric data highlights rapid expansion in this area, with key themes including adaptive sequencing, learner modeling and recommendation systems becoming prominent (K. C. Li & Wong, 2023). Reviews of AI-driven personalized learning in higher education consistently show positive effects on achievement, though the effectiveness varies more with how well the instruction is integrated than with the complexity of the technology itself (K. C. Li et al., 2024). Huang and Hwang (2024) observe a similar trend in language education, noting a shift from assessing individual tools to exploring how AI is incorporated into broader instructional frameworks. Ma et al. (2024) trace the development of AI in language teaching from 1990 to 2023, revealing that most empirical research is concentrated in East Asian and European regions, indicating significant regional disparities in the available evidence.

The release of large language models has transformed this landscape. Kohnke et al. (2023) highlight the pedagogical benefits of generative AI in language education, such as instant text generation, conversational practice, and real-time feedback. Xiao and Zhu (2025) explore how generative AI-driven writing instruction in EFL contexts, noting increasing but uneven evidence. Lee and Jeon (2025) observe that research on AI in language classrooms mainly focuses on short-term interventions. Godwin-Jones (2024) argues that generative AI shifts decision-making power among learners, teachers, and systems, often beyond current pedagogical frameworks. Pegrum (2025) warns that claims of a revolutionary change in language learning is ahead of the actual evidence.

Self-Directed Learning and Learner Autonomy

Learner autonomy, as defined by Holec (1981), is “the ability to take charge of one’s own learning” (p. 3). It involves setting goals, choosing content and methods, monitoring progress, and assessing results. Knowles (1975) described self-directed learning as a process that moves from needs diagnosis and goal setting to locating resources, implementing strategies, and evaluating outcomes. These two ideas overlap: autonomy is a capacity, while self-directed learning is the process of exercising that capacity. Both differ from self-regulation which Zimmerman (2002) defines as not an ability but "the self-directive process by which learners transform their mental abilities into academic skills” (p. 65). This distinction is important because it suggests that AI tools cannot directly grant autonomy; they only influence the conditions under which learners develop it through self-directive processes. Current research views all three as developmental and influenced by instructional design.

Technology has historically played a role in this development. Lin et al. (2023) review research on digital and self-regulated learning, finding that technological environments aid self-regulation mainly when paired with clear strategy instruction. Mohammadi Zenouzagh et al. (2023) observe that multimodal, computer-mediated writing tools boost learner autonomy, engagement, and satisfaction compared to text-only environments. Afzaal et al. (2023) show that

explainable AI-driven recommendations enhance self-regulation, while opaque ones do not, suggesting that transparency influences the impact of AI feedback on self-regulatory improvements. Chang et al. (2023) develop design principles for chatbots supporting self-regulated learning, emphasizing goal setting, feedback, and personalization as key features.

A contrasting body of research points out potential risks. Darvishi et al. (2024) show that AI support can diminish student agency when learners rely on the system for cognitive tasks, and improvements during assistance do not last after support is removed. Chan and Hu (2023) note that students value generative AI for saving time but remain concerned about its effects on their growing skills. Łodzikowski et al. (2023) and Sullivan et al. (2024) frame these worries within broader discussions on academic integrity while Evangelista (2025) contends that assessment methods must be redesigned to maintain student autonomy.

Artificial Intelligence and Learner Autonomy in EFL Contexts

Research on AI and autonomy in EFL contexts shows generally positive but conditional outcomes. Wei (2023) reported that AI-supported teaching enhanced English achievement, motivation for learning a second language, and self-regulated learning, with the most substantial effect on self-regulation. Jin et al. (2023) found similar improvements in self-regulated learning in online settings, again dependent on scaffolding. Feng (2025) explored cognitive load and learning results, discovering that AI-assisted methods lowered extraneous load and improved outcomes — but only when task design constrained the learner's capacity to offload essential processing. Hsu et al. (2024) combined AI image recognition with self-regulation techniques, noting increases in vocabulary acquisition together with reductions in learning anxiety. Çelik et al. (2024) simplified authentic texts using AI and recorded higher comprehension and reduced anxiety in Turkish EFL students, though they cautioned that a single intervention cannot produce long-lasting effects. Yang and H. Li (2024) reviewed the field and concluded that, although rapidly growing, the evidence primarily relies on short-term studies.

Research in Arab EFL Settings

Research in Arab EFL contexts is relatively limited but growing, with much of it appearing in regional journals. Adnan and Sayadi (2021) assessed the readiness of Saudi ESL students to independently develop as writers and found they lacked the necessary independence for self-study. This aligns with Aldawsari and Al Fadda (2023), who reported consistently low levels of self-direction in Saudi EFL classes following the 2019 coronavirus pandemic. Similarly, Arafat and Al Khshali (2025) noted that instructors in a tertiary Arab EFL setting consider learner autonomy desirable but see institutional and cultural factors as barriers to its development. Bashatah (2024) built automated writing evaluation into Saudi EFL students' writing routines and recorded gains in accuracy, though the benefit a learner gained depended on the autonomy they brought to the task. Daweli and Mahyoub (2024) surveyed Arab EFL learners about their views on AI tools in reading lessons. They found general approval, though students expressed concerns regarding the accuracy of these tools and their cultural appropriateness. Pitychoutis (2024) examined how AI chatbots affect EFL essay writing, highlighting both educational benefits and the risks of overdependence. Alarifi et al. (2025) assessed attitudes, engagement, and satisfaction among EFL undergraduates using AI for reading comprehension, finding high satisfaction alongside limited behavioural engagement. Jahara and Abdelrady (2021) identified pronunciation challenges arising from the typological differences between Arabic and English, which limit the effectiveness of speech

recognition tools. Meanwhile, Alruwaili et al. (2025) and Al-Smadi et al. (2024) expand this understanding by demonstrating that teachers' motivation to adopt AI is more heavily affected by institutional support and opportunities for professional growth than by their overall attitudes toward technology.

The latest regional research sharpens the focus on over-reliance issues. Avsheniuk et al. (2025) surveyed university educators about students' AI use in language classes and found that dependence on AI-generated outputs was linked to less independent problem-solving, weaker retention of vocabulary learned solely through AI, and lower engagement in collaborative tasks. They recommended that institutions set clear boundaries, emphasizing that AI should serve as "an academic aide, not an academic substitute" (p. 16). Mahfouz and AbdelMohsen (2025) surveyed 521 Egyptian undergraduates and observed a pattern relevant to this review: students rated AI as highly useful and easy to use. However, they also expressed concerns about its impact on their creativity and critical thinking (p. 35). This suggests that positive attitudes toward AI do not necessarily indicate pedagogical benefits, as learners can hold both views at once. Similarly, Altamimi (2025) reported that Saudi male EFL learners appreciated AI feedback for surface errors but found it inadequate for addressing the contextual and cultural aspects of writing development. Lehfid et al. (2025) discovered that Moroccan secondary school teachers considered AI's transformative potential alongside concerns about maintaining traditional qualities in English teaching. Collectively, this 2025 evidence suggests that Arab EFL literature has begun to move beyond attitude measurement toward how AI affects the learning process.

Summary of the Literature Review

This body of work leads to three conclusions. First, AI can facilitate personalized and self-directed learning outcomes, but its effectiveness depends on factors like instructional design, feedback transparency and learners' readiness for autonomy. Second, over-reliance risks have been documented across various contexts, especially where learners are used to depending on authority. Third, the evidence for Arab EFL learners remains scattered across regional and international sources with no comprehensive synthesis focusing specifically on self-directed learning outcomes. This review aims to fill that gap by synthesizing the empirical studies published from 2021 to 2026 in Q1 and Q2 journals.

Methodology

Research Design

Identification, selection and synthesis were guided throughout by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021) to ensure a rigorous and transparent procedure across the literature on AI-supported personalized and self-directed learning in English language teaching with Arab learners. I employed a qualitative synthesis approach, focusing only on peer-reviewed journals that are ranked as Q1 or Q2 according to the Scimago Journal Rank (SJR) or the Journal Citation Reports (JCR).

Search Strategy

The searches included six databases: Web of Science, Scopus, ERIC, IEEE Xplore Digital Library, ProQuest Education Database, and Google Scholar and involved screening the first 200 results for each query. Four concept blocks were connected using Boolean operators: AI

technologies; personalized and self-directed learning; English language education; and Arab learners. These were combined as follows.
("artificial intelligence" OR "AI" OR "machine learning" OR "adaptive learning" OR "intelligent tutoring" OR "chatbot" OR "conversational AI" OR "generative AI" OR "ChatGPT" OR "large language model") AND ("English language learning" OR "EFL" OR "ESL" OR "language education") AND ("Arab" OR "Middle East" OR "Saudi" OR "UAE" OR "Egypt" OR "Jordan" OR "Morocco" OR "Gulf")

Citation searching was then carried out in both directions in Google Scholar, working outwards from the reference lists of the included studies and inwards from works that cite them, to capture additional relevant publications.

Inclusion and Exclusion Criteria

Criteria set in advance were used to identify studies that were both relevant and methodologically sound. A study qualified if it described both the AI technology used and the observed learning outcomes; addressed AI in relation to personalized or self-directed learning; was situated within English language education (EFL or ESL); involved learners or educators in Arab countries, or Arab EFL learners elsewhere; reported empirical findings using a quantitative, qualitative, or mixed-methods design; appeared between 2021 and 2026 in a peer-reviewed journal ranked Q1 or Q2 on SJR or JCR and was available in full text in English.

A study was excluded if it duplicated or significantly overlapped with another publication, discussed AI broadly without mentioning language learning, focused solely on non-Arab settings without applying to Arab EFL education, was purely theoretical with no empirical data, was unavailable in English, was published before 2021, appeared in a journal ranked Q3, Q4, or unranked, or was in the form of a conference paper, dissertation, book chapter, or grey literature.

Study Selection Process

Selection followed the four stages of PRISMA, as summarized in Figure 2. Initial identification yielded 3,847 records; EndNote 20 removed 1,691 duplicates, leaving 2,156 unique records. During screening, two reviewers independently evaluated the titles and abstracts against the eligibility criteria and resolved disagreements through discussion, identifying 287 potentially relevant studies. In the full-text eligibility review, the same two reviewers examined 287 articles and excluded 89 for reasons such as an ineligible population (32), inappropriate intervention focus (27), inappropriate study design (18), publication in a journal below Q2 (8), and lack of full-text availability (4). During the final inclusion stage, 42 studies were excluded for weak methodology, leaving 156 studies for qualitative synthesis.

Quality Assessment

The appraisal utilized items adapted from the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018), along with relevant checklists from the Critical Appraisal Skills Program. In each case, eight factors were evaluated: ethical considerations; transparency in reporting and acknowledging limitations; adequacy of the sample and validity and reliability of the instruments; the rigor of data collection and analysis; appropriateness of the design for the research question; and clarity of the objectives. Based on these criteria, studies were categorized into high, moderate, or low bands, and those in the lowest band were excluded prior to synthesis.

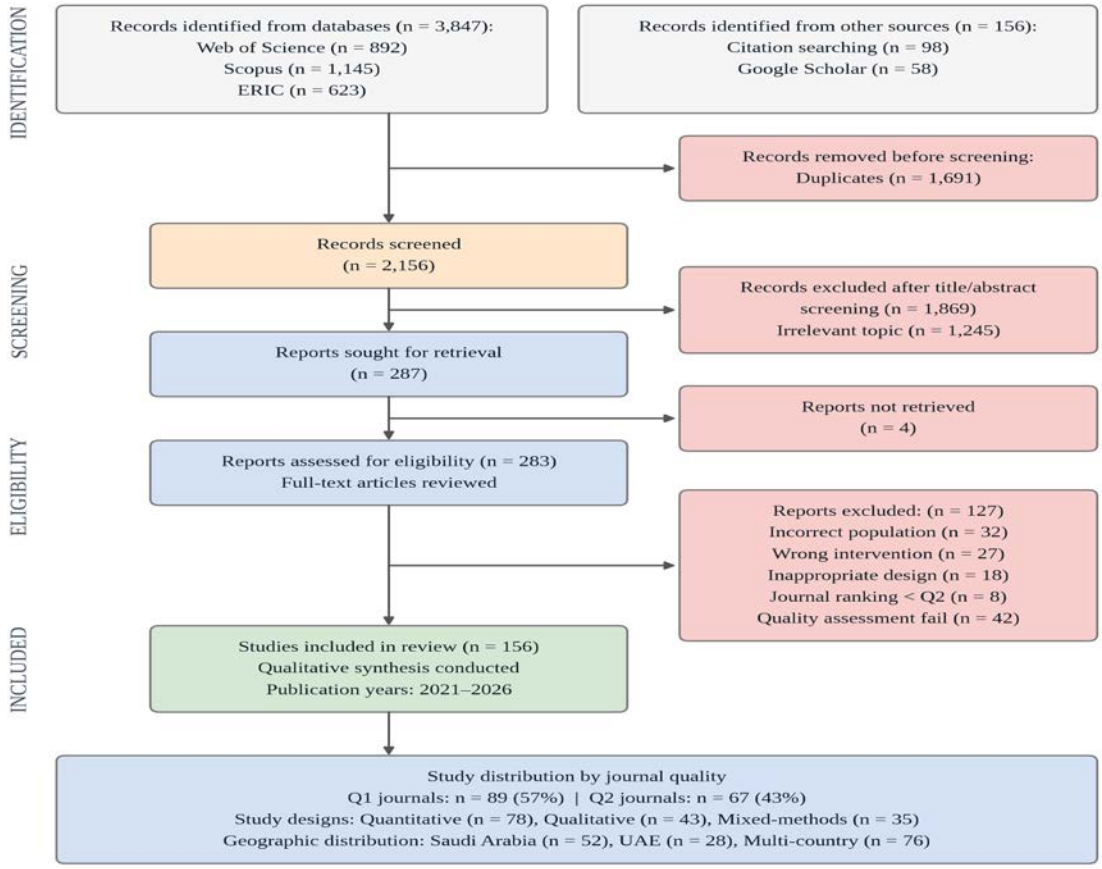


Figure 2. PRISMA 2020 flow diagram of the identification, screening, eligibility, and inclusion stages of study selection

Data Extraction and Synthesis

An extraction form was developed, piloted on ten studies, and then applied across the entire corpus. It included fields for bibliographic data, study design and participant details, a description of the AI technology, the self-directed learning constructs evaluated, the intervention duration, outcome measures, main findings, and recommendations for Arab EFL contexts. Two reviewers independently extracted data and resolved disputes through discussion. Following Popay et al. (2006), narrative synthesis was employed due to the heterogeneity of study designs and interventions, which was in line with their guidance. The synthesis was organized thematically, focusing on the type of AI technology, self-directed learning skills targeted, learning outcomes and effectiveness, contextual factors and challenges, and pedagogical implications.

Treatment of Reported Effect Sizes

No statistical meta-analysis was conducted in this review. Heterogeneity in designs, outcome measures, intervention durations, and comparison conditions across the corpus prevented pooling results, so the review remains narrative throughout. When effect sizes are mentioned in the Results section and Table 2, they are descriptive summaries of the standardised mean differences reported by individual primary studies and are shown as ranges where applicable. The figure d = 0.58 for writing outcomes is the arithmetic mean of the effect sizes from studies that

provided them; it is not a weighted, pooled meta-analytic estimate. As a result, no pooling model, heterogeneity statistic, publication bias assessment, or meta-analytic software is reported, since none was used. These figures should be viewed as indications of the effect sizes in individual studies, not as population estimates, as stated among the review's limitations.

Artificial Intelligence Tools Documented in the Corpus

Since generative AI played a key role in the synthesis, the corpus is classified by technology here. Studies are categorized into six functional groups, detailed in the Results section: conversational AI agents and chatbots (42 studies, 26.9%), intelligent tutoring systems (38 studies, 24.4%), adaptive learning platforms (35 studies, 22.4%), automated feedback systems (29 studies, 18.6%), learning analytics tools (24 studies, 15.4%), and AI-assisted content generation (18 studies, 11.5%). These categories are not mutually exclusive, as some studies explore platforms with multiple functions. In such cases, a study is assigned to the category that matches the function being examined rather than all functions present in the platform.

Within the conversational tools category, generative large language models formed a distinct subgroup. ChatGPT was the focus of 28 studies, making it the most commonly studied tool in the dataset. These studies used ChatGPT in four main roles: (i) as a conversation partner for speaking and writing practice, (ii) as a feedback generator for learner-produced texts, (iii) as a creator of reading passages, prompts and exercises tailored to specific proficiency levels and (iv) as an explanation engine that responded to learner questions about grammar and vocabulary. Other frequently mentioned tools included automated writing evaluation systems like Grammarly, institutional automated essay scoring platforms, speech recognition and pronunciation assessment tools, adaptive vocabulary systems employing spaced repetition algorithms, and learning analytics dashboards integrated into institutional learning management systems. Since numerous studies mentioned proprietary or locally developed systems without specific names, tools were categorized based on their function rather than their product, making it impossible to provide an accurate count of individual products. This is described as a limitation of the classification, not as a finding.

The primary studies employed five types of instruments to measure outcomes: validated self-report scales assessing self-regulation, learner autonomy, and motivation; standardized or institutionally administered language proficiency tests; analytic rubrics for evaluating writing and speaking skills; semi-structured interview and focus group protocols; and platform-generated log data capturing usage frequency and patterns. Where studies reported effect sizes, they mainly originated from pre-test and post-test comparisons of proficiency measures rather than self-report scales.

Results

Overview of Included Studies

The search and selection process identified 156 empirical studies published in Q1 and Q2 journals from 2021 to 2026. These studies explored various aspects of AI-based personalized learning and self-directed learning in English language teaching, with a focus on Arab EFL settings. As shown in Table 1 and Figure 3, the studies' geographic distribution included 52 (33.3%) from Saudi Arabia, 28 (17.9%) from the United Arab Emirates, 18 (11.5%) from Egypt, 12 (7.7%) from Jordan, and eight (5.1%) from other Arab countries. Additionally, 38 studies (24.4%) involved multi-country samples with Arab populations. Publication activity increased

significantly over the review period, from 18 studies in 2021, to 24 in 2022, 31 in 2023, 42 in 2024, 35 in 2025, and six in the partial year 2026.

Table 1. *Characteristics of the 156 included studies by geographic distribution, publication year, research design, and educational level*

Characteristic	Category	*n*	%
Geographic distribution	Saudi Arabia	52	33.3
	United Arab Emirates	28	17.9
	Egypt	18	11.5
	Jordan	12	7.7
	Other Arab countries	8	5.1
	Multi-country samples	38	24.4
Publication year	2021	18	11.5
	2022	24	15.4
	2023	31	19.9
	2024	42	26.9
	2025	35	22.4
	2026	6	3.8
Research design	Quantitative	78	50.0
	Qualitative	43	27.6
	Mixed methods	35	22.4
Educational level	University	89	57.0
	Secondary school	38	24.4
	Adult language institutes	21	13.5
	Elementary school	8	5.1

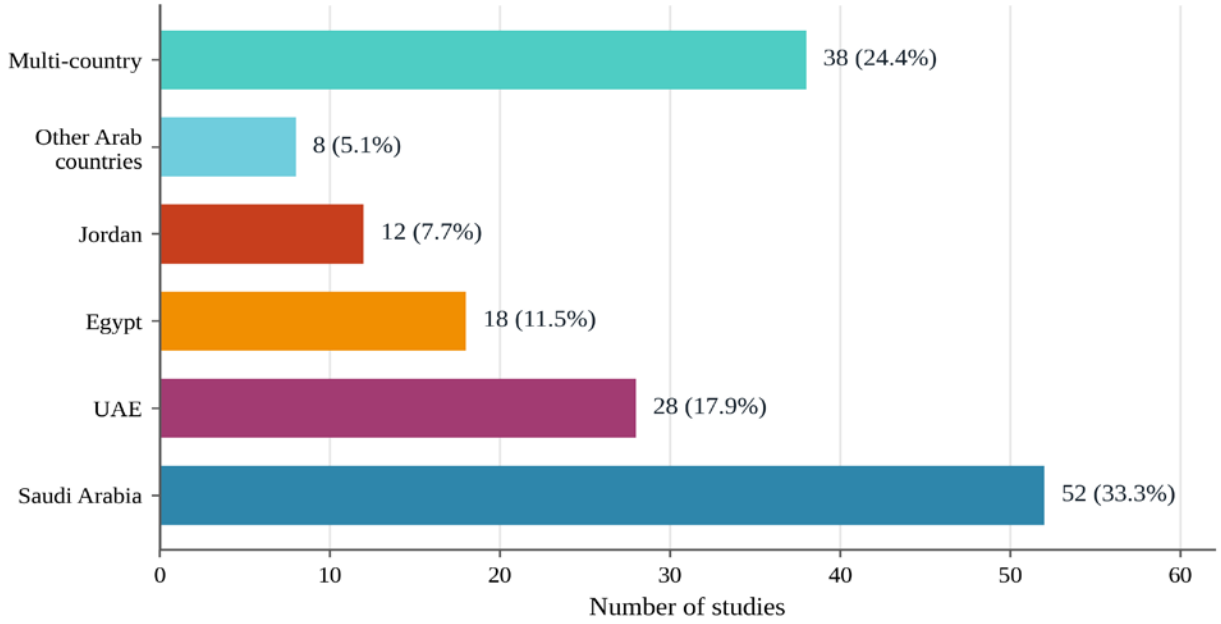


Figure 3. Geographic distribution of the 156 included studies across Arab countries and multi-country samples

Methodologically, 78 studies (50.0%) employed quantitative designs, mainly experimental or quasi-experimental, to assess the impact of AI interventions on learning outcomes and self-directed learning skills. 43 studies (27.6%) used qualitative methods, exploring learner and teacher perceptions, experiences, and challenges through interviews, focus groups, and classroom observations. 35 studies (22.4%) adopted mixed methods, combining quantitative effectiveness data with qualitative insights into user experience and context (Huang & Hwang, 2024). Sample sizes ranged widely from small qualitative studies with 12 to 30 participants to large-scale quantitative studies exceeding 500, with a median of 156. Participants included university students (89 studies, 57.0%), secondary students (38 studies, 24.4%), adult learners at language institutes (21 studies, 13.5%) and elementary students (eight studies, 5.1%). Intervention durations varied from brief four- to six-week periods (42 studies) to semester-long periods of 12 to 16 weeks (87 studies) and longer longitudinal studies (27 studies).

Artificial Intelligence Technologies for Personalized Learning in Arab EFL Contexts

The synthesis identified six main categories of AI technology used to support personalized and self-directed learning in Arab EFL settings. Among these, conversational AI agents and chatbots were the most studied, appearing in 42 studies (26.9%). These tools provided learners with authentic language practice and immediate feedback. The emergence of generative AI, particularly ChatGPT, from 2022 onwards marked a major shift, with 28 studies focusing specifically on these technologies (Yang & H. Li, 2024; Xiao & Zhu, 2025; Lee & Jeon, 2025).

Intelligent tutoring systems that offer personalized and adaptive instruction were examined in 38 studies (24.4%) (Wei, 2023; Huang & Hwang, 2024). 32 studies (22.4%) focused on adaptive learning platforms employing machine learning algorithms to identify knowledge gaps and provide tailored recommendations (Feng, 2025; Jin et al., 2023). Automated feedback systems, which provide immediate comments on learner outputs, were discussed in 29 studies (18.6%) (Jahara & Abdelrady, 2021; Bashatah, 2024). Learning analytics tools visualizing learner data and progress appeared in 24 studies (15.4%) (Aldawsari & Al Fadda, 2023). Lastly, 18 studies (11.5%) explored AI-assisted content generation (Daweli & Mahyoub, 2024).

Impact on Self-Directed Learning Competencies

The synthesis provided substantial evidence on the effects of AI technologies on several components of self-directed learning among Arab EFL learners. Figure 4 shows the distribution of studies across these competencies, with learner autonomy the most extensively investigated outcome. Learner autonomy, understood as the overall capacity to learn independently, was examined in 89 studies (57.1%). The findings were nuanced: most studies reported positive effects but were consistently moderated by context. AI technologies that provided scaffolded independence by balancing support and autonomous decision-making were most effective for Arab learners (Alrabai, 2021; Lin et al., 2023).

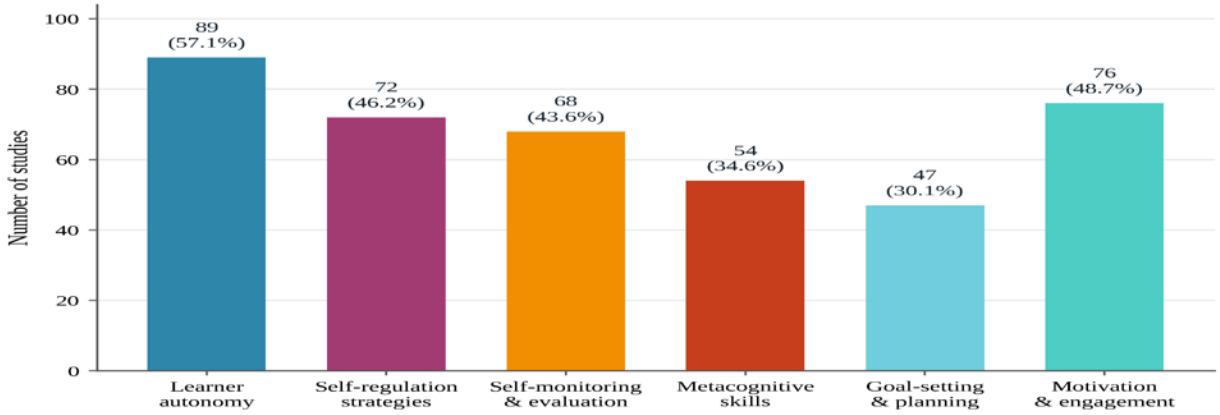


Figure 4. Number of included studies addressing each self-directed learning competency (n = 156)

AI technologies had a positive effect on self-regulation strategies, encompassing cognitive, metacognitive, and behavioural regulation, in 72 studies (46.2%). Tools that support improvements in self-regulation included features like study scheduling, attention management prompts, strategy recommendations from learning analytics, and adaptive scaffolding that customized support according to user performance. Using validated self-regulation scales, Wei (2023) and Jin et al. (2023) recorded statistically significant improvements in planning, monitoring, and evaluation strategies among Arab learners using AI tools, compared with groups receiving conventional instruction.

68 studies (43.6%) reported that AI technologies improved self-monitoring and progress evaluation. Intelligent feedback systems, automated assessment tools and learning analytics dashboards provided learners with continuous access to performance data, enabling real-time self-assessment and progress tracking. Arab EFL learners using these tools demonstrated higher levels of metacognitive awareness, assessed their language ability more accurately, and identified their strengths and weaknesses more precisely. However, several studies found that explicit instruction and scaffolding were prerequisites for effective self-monitoring, particularly among learners with little prior experience of independent study (Arafat & Al Khshali, 2025; Adnan & Sayadi, 2021).

The development of metacognitive skills was addressed in 54 studies (34.6%). AI technologies that made thinking processes visible by tracking them, explained the reasoning behind automated feedback, or prompted reflective activity were associated with gains in metacognitive awareness. However, some studies cautioned that excessive dependence on AI recommendations may impair metacognitive activity when learners accept suggestions without critical evaluation (Pegrum, 2025; Darvishi et al., 2024). 47 studies (30.1%) reported positive effects on goal setting and learning planning, with intelligent tutoring systems and adaptive platforms showing appreciable effects on learners' ability to formulate specific and measurable goals (Chang et al., 2023; Hsu et al., 2024).

Learning Outcomes and Effectiveness

Across every skill area, the evidence pointed predominantly in one direction: AI technologies were associated with improved English language proficiency. Table 2 summarizes the reported effect sizes for six skills. Writing was the most extensively researched area, appearing in 58 studies (37.2%). AI-supported writing aids, automated feedback systems, and intelligent writing tutors were consistently associated with improvements in writing quality. Across the primary studies that reported standardized effect sizes for overall writing quality, the mean of those reported values was d = 0.58. As noted in the Methodology, this is a descriptive average of individually reported effects, not a pooled meta-analytic estimate (Yang & H. Li, 2024; Xiao & Zhu, 2025).

Table 2. *Effect sizes reported by the included primary studies for English language learning outcomes across six skill areas*

Language skill	Studies (n)	% of total	Reported effect size (Cohen's d)	Principal findings
Writing	58	37.2	0.58 (mean of reported values)	Consistent improvement in overall quality, organization, and grammatical accuracy
Vocabulary	52	33.3	0.45–0.75	Robust gains associated with spaced repetition systems

Grammar	46	29.5	0.38–0.62	Effective for structures differing between Arabic and English
Speaking	41	26.3	0.32–1.14	Improved fluency and pronunciation; reduced speaking anxiety
Reading	39	25.0	0.41–0.89	Better comprehension and reading speed; improved vocabulary retention
Listening	28	17.9	0.28–0.54	Modest improvement; comprehension of authentic input remained difficult

Note. Values are descriptive summaries of standardised mean differences (Cohen's d) reported by individual primary studies. They are not pooled meta-analytic estimates; no statistical pooling, heterogeneity testing, or publication bias assessment was conducted.

Vocabulary acquisition outcomes were examined in 52 studies (33.3%), in which AI-based spaced repetition systems, context-sensitive vocabulary assistants, and adaptive flashcard applications consistently showed positive results. Studies using pre- and post-test vocabulary measures reported substantial gains, with effect sizes ranging from d = 0.45 to d = 0.75 (Hsu et al., 2024). A total of 46 studies (29.5%) reported improvements in grammatical knowledge and accuracy, highlighting the effectiveness of intelligent tutoring systems that provide targeted grammar instruction, especially for structures that vary significantly between Arabic and English.

Speaking proficiency improved in 41 studies (26.3%), highlighting the effectiveness of AI-powered conversational agents and pronunciation assessment tools. Effect sizes ranged from small to large (d = 0.32 to d = 1.14), with longer interventions producing bigger effects. Arab learners practising with AI speaking partners showed significant gains in fluency, pronunciation accuracy, and confidence in communication (Huang & Hwang, 2024; Feng, 2025). Reading comprehension was assessed in 39 studies (25.0%), and AI-driven adaptive reading tools showed noticeable benefits, with effect sizes between d = 0.41 and d = 0.89, depending on learner proficiency (Lee & Jeon, 2025; Çelik et al., 2024).

Learner and Teacher Perceptions

Learner perceptions of AI technologies in Arab EFL settings were investigated across 103 studies (66.0%). Arab learners mostly held positive views, with satisfaction scores ranging from 3.8 to 4.6 on five-point Likert scales. They rated these technologies as highly useful, particularly appreciating features such as accessibility, availability and personalization. One of the most common benefits mentioned was the chance to practise speaking English anytime without fear of judgment (Daweli & Mahyoub, 2024; Chang et al., 2023; Alarifi et al., 2025). Perceived ease of use varied with digital literacy levels: younger learners often used AI tools confidently without training while older learners faced challenges and needed continuous training and technical support (Aldawsari & Al Fadda, 2023).

Learner concerns primarily focused on over-reliance on technology and reduced critical thinking (34 studies), privacy and data security issues (28 studies), and technical limitations (41 studies), including problems like inaccurate feedback and culturally inappropriate content (Pegrum, 2025; Xiao & Zhu, 2025). A strong preference for human interaction persisted, with 47 studies indicating that learners favored human teachers for motivation and detailed feedback (Arafat & Al Khshali, 2025). Teacher perceptions, investigated in 67 studies (42.9%), revealed mixed views. While teachers recognized the benefits of AI for differentiation and feedback, they also expressed concerns about its pedagogical suitability and potential to diminish their

professional roles. Effective professional development was identified as crucial for fostering positive attitudes and successful implementation (Alrabai, 2021; Alruwaili et al., 2025).

Challenges and Implementation Barriers

The synthesis identified several challenges in the effective implementation of Artificial Intelligence within Arab EFL contexts, as summarized in Figure 5. Pedagogical issues were documented in 82 studies (52.6%). The most frequently cited concern was an over-reliance on AI assistance. Some studies noted that learners tended to become passive recipients of AI-generated content rather than actively engaging with the language, especially when working on writing tasks using generative AI tools (Yang & H. Li, 2024; Xiao & Zhu, 2025).

Technical issues were identified in 76 studies (48.7%), involving infrastructure, connectivity, and AI system accuracy. In parts of the Arab world, poor internet connectivity hindered access to cloud-based AI services. Documented system limitations included reduced speech-recognition accuracy for non-native accents and failure to identify errors arising from Arabic influence on English (Jahara & Abdelrady, 2021; Feng, 2025). 44 studies raised concerns about data privacy and ethics, highlighting issues of transparency in data collection and the surveillance risks associated with learning analytics.

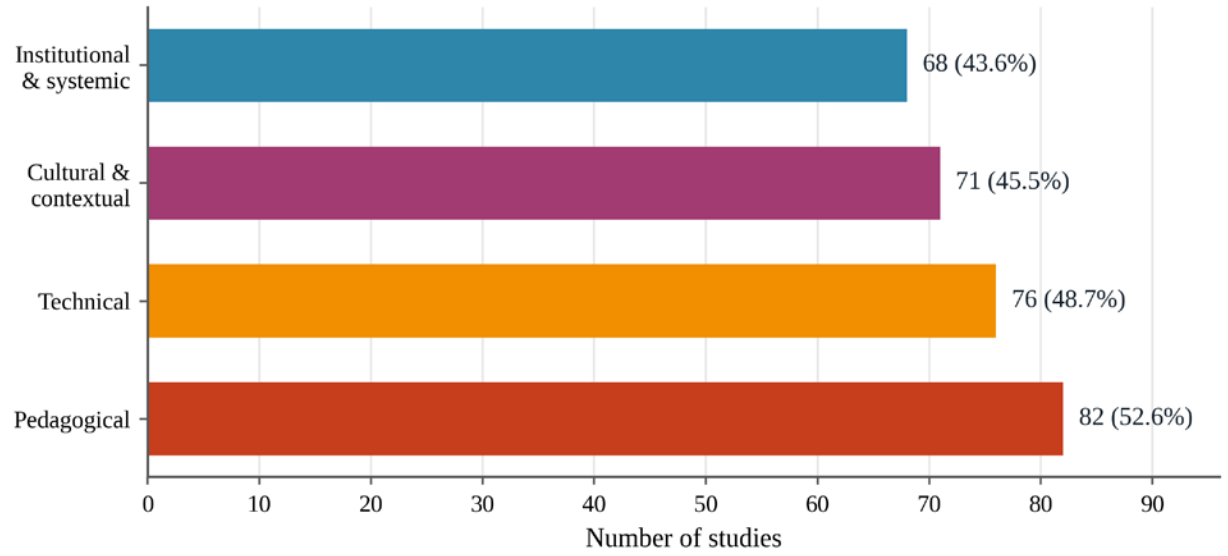


Figure 5. Frequency of reported implementation challenges and barriers across the included studies (n = 156)

Cultural and contextual challenges specific to Arab EFL contexts were highlighted in 71 studies (45.5%). A common issue was the disconnect between AI-enabled personalized learning and the teacher-centred pedagogy prevalent in many Arab institutions. Readiness for independent learning posed a significant challenge, as research showed that Arab learners' strong dependence on teachers hindered the adoption of AI tools (Arafat & Al Khshali, 2025; Adnan & Sayadi, 2021). Additionally, 33 studies expressed concerns about the cultural appropriateness of AI-generated content.

Institutional barriers, identified in 68 studies (43.6%), included issues like lack of funding, inadequate teacher training, and resistance to change. (Aldawsari & Al Fadda, 2023; Al-Smadi et al., 2024). Despite these challenges, 94 studies (60.3%) reported successful implementation. Facilitating factors included support from institutional leadership, thorough professional

development for teachers, models that integrate AI with human instruction, and AI tools adapted to local cultures (Jin et al., 2023; Chang et al., 2023).

Discussion

This section initially addresses the three research questions directly before contextualizing the findings within broader theoretical and empirical literature.

Answers to the Research Questions

RQ1: The Effect of AI on Self-Directed Learning Skills and Learner Autonomy

The evidence suggests that AI positively influences Arab EFL students' self-directed learning skills and autonomy, but under certain conditions. Out of 89 studies on learner autonomy, most showed a positive effect, with additional improvements seen in self-regulation (72 studies), self-monitoring (68 studies), metacognitive awareness (54 studies), and goal setting (47 studies). However, this effect depends on three specific factors. First, AI tools' effectiveness depends on scaffolding: those offering graduated support and genuine learner decision-making opportunities lead to better outcomes, while tools that provide complete solutions do not. Second, learners' initial readiness plays a key role; students with very low autonomy need explicit strategy instruction before they can benefit. Third, the transparency of AI feedback is important. Learners who received clear, understandable recommendations demonstrated greater self-regulation than those who were given vague suggestions (Afzaal et al., 2023). Overall, the answer to RQ1 is that AI can support self-directed learning when pedagogically designed to do so, but the technology alone is insufficient.

RQ2: Benefits of AI-Assisted Personalized Learning Systems

Four benefit categories emerged. The first is differentiation at scale: adaptive systems provide personalized content and pacing to large groups in institutional settings where class sizes prevent individual attention, addressing a structural challenge in Arab educational systems as noted by Alrabai (2021). The second is immediate formative feedback, which reduces the time between production and correction and is linked to measurable improvements in writing (58 studies) and grammatical accuracy (46 studies). The third advantage is low-anxiety practice, where having a non-judgemental interlocutor was the most commonly reported benefit by learners. This was linked to improvements in speaking fluency and communication confidence across 41 studies. The fourth benefit is expanded access, as AI tools provided practice opportunities beyond the classroom and teacher availability, which is especially important in EFL contexts with limited exposure to authentic language. The most significant improvements were seen in writing and speaking, while progress in listening was more limited.

RQ3: Challenges to Cognitive Engagement, Authentic Interaction, and Autonomous Development

Three significant challenges stand out. The first is cognitive offloading, which was the most frequently reported pedagogical issue across 82 studies. Generative tools allow learners to produce finished work without engaging in the necessary linguistic effort. Darvishi et al. (2024) note that the benefits observed in such scenarios tend to fade when the assistance is withdrawn. The second challenge involves the lack of genuine authenticity in AI-mediated interactions. While conversational agents offer practice opportunities, 47 studies show that learners still prefer human

teachers, and the analysis below suggests that AI better supports autonomy and competence than relatedness. The third challenge is the cultural and pedagogical misalignment. AI personalization assumes learners have the freedom to choose, but in many Arab institutions, the teacher remains the main source of guidance. 71 studies reveal the effects of this mismatch, and 33 highlight concerns about whether AI-generated content fits the cultural context. Technical issues also add to these problems, as lower speech recognition accuracy for Arabic-influenced English reduces the reliability of feedback that is crucial for autonomous practice (Jahara & Abdelrady, 2021).

Synthesis of Key Findings

The synthesis of 156 high-quality studies published between 2021 and 2026 highlights both the potential of AI technologies in Arab EFL education and substantial barriers to implementation. Research focus on conversational AI, particularly ChatGPT, indicates an rapid technological shift. AI-based platforms support autonomous learning by creating personalized experiences (Godwin-Jones, 2024; K. C. Li et al., 2024). The emphasis on learner autonomy across 89 studies confirms its central status, and the effect of AI on autonomy varies with pedagogical strategy and learners' characteristics (Chan & Hu, 2023; Darvishi et al., 2024). Effects on language proficiency outcomes were consistently positive (Kohnke et al., 2023; Pitychoutis, 2024).

Theoretical Implications

From a self-determination theory perspective, AI supports autonomy and competence but addresses relatedness poorly, implying a need for blended strategies that incorporate human interaction in collectivist Arab cultures (Mohammadi Zenouzagh et al., 2023). Sociocultural perspectives suggest that AI offers scaffolding, but evidence raises questions about whether this support fosters internalization or creates dependence. The impact seems to rely on learners' initial readiness for autonomy (Bashatah, 2024). Metacognitive theory explains the observed improvements in self-monitoring and also why overuse might hinder independent metacognitive growth (Afzaal et al., 2023). While technology acceptance models align with perception data, their traditional concepts of perceived usefulness and ease of use appear inadequate to address the privacy and cultural issues highlighted here (Al-Smadi et al., 2024).

Pedagogical Implications for Arab EFL Contexts

The evidence supports blended approaches that combine AI with human instruction. In Arab educational cultures where authority typically lies with the teacher, models that position AI as an assistant, not a replacement, align with prevailing expectations (Avsheniuk et al., 2025). Learners with low autonomy require structured guidance and a gradual release of responsibility (Lin et al., 2023). Cultural appropriateness requires either selecting adapted tools or deliberately using culturally inappropriate outputs as material for critical discussion (Çelik et al., 2024). The risk of over-reliance highlights the need for explicit guidance on responsible use rather than assuming user competence.

Comparison with Existing Literature

This review's findings complement existing systematic reviews while providing additional insights specific to Arab contexts. Like recent syntheses, it confirms AI's effectiveness for language development (Huang & Hwang, 2024). Its emphasis on self-directed learning, however, uncovers context-specific patterns in autonomy that broader reviews overlook (K. C. Li & Wong,

2023). Focusing on Arab settings highlights cultural elements such as maintaining teacher authority and institutional resistance to change. Recent reviews show an increasing body of AI research in language learning but also indicate that Arab populations remain underrepresented (Ma et al., 2024). Regarding self-directed learning, this review builds on existing studies by exploring how technology influences autonomy development, complementing the traditionally sociocultural focus of previous research. (Zaheer, 2025; Alruwaili et al., 2025).

Conclusion

This review of 156 empirical studies published from 2021 to 2026 confirms that AI can enhance self-directed learning in Arab EFL education, showing improvements in learner autonomy, self-regulation, metacognitive awareness, and goal setting, as well as in productive skills like writing and speaking (Ifenthaler et al., 2024; Săseanu et al., 2025). The findings also highlight that these outcomes are influenced more by pedagogical approaches and cultural relevance than by the technology itself (Sullivan et al., 2024; Atkinson-Toal & Guo, 2024). Four main challenges emerged: reliance on AI-generated outputs and the resulting decline in critical engagement; uneven technological infrastructure; insufficient teacher training; and a mismatch between imported tools and local cultural contexts (Łodzikowski et al., 2023; Dabis & Csáki, 2024).

Overall, the evidence suggests that effective AI integration depends on human guidance, blended approaches, phased implementation, and institutional support (Ifenthaler et al., 2024). This review offers a context-specific synthesis for Arab EFL environments, emphasizing that AI must be introduced thoughtfully, considering pedagogical and ethical factors. The most justified stance is not outright acceptance or rejection, but a balanced implementation that prioritizes learning, culture, and the teacher. (Dervić et al., 2025; Azis & Isnani, 2024).

Limitations of the Review

Several limitations affect these conclusions. First, limiting the search to six databases and English-language articles introduces a language bias, potentially excluding relevant Arabic-language studies from regional outlets. As a result, the views of learners and teachers in less visible institutions may be under-represented. Second, only Q1- or Q2-ranked journals were included, excluding conference papers, dissertations, book chapters, and grey literature. While this choice prioritized methodological quality, it also increased the risk of publication bias, since studies with null or negative AI effects are less common in top-tier journals. Third, a statistical meta-analysis was not performed. The reported effect sizes are descriptive summaries from individual studies, not pooled estimates, and they were not weighted by sample size or precision. No formal assessment of heterogeneity or publication bias was conducted. Fourth, the definition of the Arab EFL population included multi-country studies that included Arab participants; therefore, 38 of the 156 studies were not exclusively focused on Arab populations, which may diminish the specificity of the findings. Fifth, the review period coincided with a period of rapid technological advancement: studies conducted prior to late 2022 examined AI tools with capabilities that differ significantly from those of current generative models, thereby limiting the comparability of findings across the period. Sixth, most included studies utilized interventions lasting one semester or less, thus conclusions regarding the durability of effects on autonomy remain provisional. Finally, two reviewers conducted screening and data extraction and resolved disagreements through discussion but no formal inter-rater reliability statistic was calculated.

Recommendations

For Educators and Practitioners

Teachers in Arab EFL contexts should implement blended approaches that integrate AI with human teaching, viewing AI as a supportive tool rather than a substitute for it (Ifenthaler et al., 2024; Sullivan et al., 2024). AI should be introduced gradually with scaffolding and guided exercises before students are expected to work independently, since many are not initially ready for autonomous AI-assisted learning (Crawford et al., 2024; Lin et al., 2023). Students also need clear instruction on responsible AI use: understanding how to seek legitimate help without over-dependence, critically assessing AI outputs, and utilizing AI for learning purposes rather than just task completion (Łodzikowski et al., 2023; Săseanu et al., 2025). Since cultural fit is important, educators should choose tools appropriate for Arab contexts or use culturally insensitive outputs as opportunities to develop cultural awareness and digital literacy (Atkinson-Toal & Guo, 2024; Azevedo et al., 2026). AI is most effective in skill areas with clear benefits, such as writing and speaking, while support for listening should be kept modest (Atkinson-Toal & Guo, 2024; Azevedo et al., 2026). AI is most productively deployed in the skill areas where the evidence of benefit is strongest, namely writing and speaking, and expectations of support for listening should remain modest (Gao et al., 2024).

For Policymakers and Institutions

Institutions should invest in professional development that extends beyond merely teaching how to use AI tools, focusing instead on pedagogy, ethics, cultural adaptation, and fostering learner autonomy (Dervić et al., 2025). Clear policies on privacy, acceptable use, academic integrity, equity, and quality standards are essential, as ambiguous guidance hinders effective implementation (Azis & Isnani, 2024; Spivakovsky et al., 2023). A phased approach to implementation is preferable to a large-scale rollout because it allows time for teacher training, infrastructure upgrades, and adaptation. Leaders should also bolster connectivity, device availability, and technical support, especially in under-resourced settings. Before widespread deployment, institutions should pilot tools to evaluate their effectiveness, privacy compliance, and cultural fit, and collaborate with developers to create AI solutions tailored specifically to Arab EFL learners' needs (Dabis & Csáki, 2024).

For Future Research

Since most of the available studies are conducted over a semester or less, the long-term implications of artificial intelligence on autonomous learning represent the primary area for future research. Key questions include identifying the most effective scaffolding approaches for learners with initially low autonomy, assessing whether culturally adapted tools outperform generic alternatives, and examining the relationship between AI utilization and academic integrity (Evangelista, 2025). Additionally, research is required to explore implementation at scale within authentic institutional settings, as well as to develop and validate instruments designed to measure self-directed learning in AI-mediated environments. Future syntheses should also incorporate studies published in Arabic and regional outlets to address the previously identified language bias.

Funding:
This research was funded by Prince Sattam bin Abdulaziz University through the project number PSAU/2025/R/1447.
Acknowledgments: The author extends her appreciation to Prince Sattam bin Abdulaziz University for funding this research work through the project number PSAU/2025/R/1447.
Conflicts of Interest: The author declares no conflicts of interest.
Authenticity: This manuscript is an original work.
Artificial Intelligence Statement: During the preparation of this manuscript, the author used Research Rabbit to find related papers and track research trends and 'Elicit' to search, summarise, and compare findings of various research studies. Claude and Grammarly were occasionally used to improve clarity and refine phrasing. The author wrote and reviewed the final manuscript without additional AI input. The author takes full responsibility for the content of this publication.

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