# Investigating the Future of ESP Teaching in the Age of Artificial Intelligence

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**Abstract**

*A tendency in education is gradually slanted towards technology-integrated language learning. The majority of countries around the world have been increasingly compelled to use computer-mediated language learning in their higher educational system to bridge the gap between the learners' requirements and the needs of the global era. This current investigation is a case study conducted on 40 English for Specific Purposes (ESP) practitioners from various Algerian Higher Education institutions. It aims to explore the teachers' perceptions towards the use of artificial Intelligence technological applications in their ESP classrooms. It also examines the future of ESP teaching in the age of this current trend. Results revealed that teachers in general are aware of using a variety of AI tools to fit the digital revolution, be up-to-date with the current technology, meet the learners' needs and wants, and assist their teaching practices such as the process of Evaluation and assessment, course design, needs analysis and Identification. It has been recommended that the Algerian government should train ESP teachers to use AI as a supportive tool and exert excessive efforts and take the lead to implementing and designing suitable courses that are intended to bridge the gap between the fieldwork and the demands of the students' virtual age.*

**Keywords:** *Age, Artificial Intelligence, ESP, future, Teaching.*

## *Introduction*

Throughout history, ESP has witnessed a dramatic evolution and various approaches to course design with the ultimate aim of helping learners function effectively in their target discourse community. Anthony (2018) proposes that ESP is characterized by its specific approaches and features, which differ from general language teaching. These are, according to him, the Learner-centered Approach of Hutchinson and Waters (1987), the Multi-disciplinary Approach of Dudley-Evans and St. John (1998), An attention to theory and practice, Task-Based Language Teaching (TBLT), Problem-Based Learning, Communicative Language Teaching (CLT), Content-based instruction (CBI). A tendency has also shifted from

traditional teaching to "online classroom", "computer-assisted education", and "personalized learning". Scholars, as well as language practitioners, seek to improve language learning through technology-based approaches (Nickerson & Planken, 2016; Rahmani & Ghounane, 2023). An example of this cutting-edge technology is Artificial Intelligence (AI).

AI is known as a multidisciplinary concept, which is basically part of the area of computer science that focuses on finding solutions to cognitive issues like learning, problem-solving, and pattern recognition, which are frequently linked to human intelligence (Viktorivna et al, 2022). It also refers to a machine- based system characterized by "…its ability in providing a simulation of human intelligence processes that are handled by machines; in particular computer systems" (Zuraina, 2020, p. 1). Similarly, according to Huang et al. (2023), AI is a human-machine system that "can make predictions, recommendations, decisions influencing real or virtual environments" (p. 112).

Since the introduction of AI by John McCarthy in the 1950s, an enormous number of applications of language learning devices have been progressively developed. They are mobile apps that have a web-based version. In this vein, these phone-based apps such as Duolingo, Rosetta, Language Pro, Memrise, and chatGPT can be downloaded via Play Store. Some of them are free of charge, and others are allocated. Each one is characterized by its own function. In general, they are used to assist students in learning a new language, correcting their grammar, learning the four skills, developing their conversation and writing skills, summarizing texts, translating, paraphrasing articles, and so on (Prenga, 2020). Muhammad (2014) defines these applications as "…electronic neural networks, developed hybrid systems, applications of developmental algorithms, electronic auto-copying, adaptive electronic platforms, bio-robots, Nano-technology, chemical and organic systems, and advanced controlling systems" (p. 18).

## *Literature Review*

### ESP Teaching in the Digital Era

English for Specific Purposes (ESP), by definition, is a goal-directed activity; it is an approach to language teaching that focuses on teaching those aspects of language use, skills, and genres that address the learners' academic and professional needs. Anthony (2018, p. 1) states that "… English for Specific Purposes (ESP) is an approach to language teaching that targets the current and/or future academic or occupational needs of learners, focuses on the necessary language, genres, and skills to address these needs, and assists learners in meeting these needs through the use of general and/or discipline-specific teaching materials

and methods." Students, in this context, play a central role, being old, knowledgeable in their field of study, and active participants in their teaching and learning process and are believed to be much more conscious of the importance of using English and their learning and target needs (Basterkmen, 2006; Kennedy & Bolitho, 1984; Hutchinson & Waters, 1987).

Thus, within the multimedia landscape and the advent of science and technology, it becomes indispensable to bridge the actual gap between the students' language requirements and the needs of their global age. This cannot be done apart, according to Constantinou and Papadima-Sophocleous (2020), far from involving ESP learners in the learning process and developing their identities as global citizens. In the same respect, Deacon, Parkin, and Schneider (2017, p. 137) argue,"…it is now widely accepted that universities have a direct responsibility to prepare students for employment, and in the 21st century, this preparation needs to include digital literacy and competencies."

As a result, an increasing trend in education is gradually oriented towards integrating technology into ESP classrooms. The majority of countries around the world have been increasingly compelled to use computer-assisted language learning (CALL) or Information Communication Technologies (ICT) in their higher educational system to modernize their curricula and their teaching frameworks, use a variety of technological evaluation and assessment techniques, and effectively respond to the process of globalization. Thus, the vision of face-to-face teaching, formal and traditional education in an ESP context becomes subject to revision and reconsideration. Different software applications have been used for pedagogical purposes. A final concern that has become an issue of heated debate is the notion of using technological tools to develop students' 21st-century skills, such as collaborative learning, critical thinking, autonomous learning, lifelong learning, etc.

There is a growing body of literature that recognizes the importance of incorporating technology into ESP classrooms; Nickerson and Planken (2016), for instance, believe that nowadays, with the arrival of blended learning, it becomes necessary to use teaching materials that incorporate diverse forms of communication, along with various media and technological tools. This approach would enhance students' comprehension of the latest media resources at their disposal, as well as their understanding of how these resources interact with each other and with conventional media. Classroom assignments and task-based simulations can play a crucial role in preparing students to utilize Business English in the context of new media while also equipping them with the skills to employ such media in a Business English workplace environment.

Likewise, Kirovska-Simjanoska (2020) considers that ESP learners are consistently connected through a variety of digital devices. Their lives are also heavily reliant on technology. Consequently, students bring with them their technological experience, as well as their beliefs and perceptions that technology should play a role in their education. Therefore, it is of great importance to shape and reshape the roles of both the learners and the teacher. He believes that the process of teaching and learning a language does not occur in a traditional classroom and should not end up after the learners leave their language classroom. Technology, according to him, has the potential to enable convenient access to content and mitigate the impact of geographical constraints.

To go a step further, Bouguebs et al. (2023) report that ESP teachers' role has to be modified to fit the requirements of the learners in today's digital world. In addition to teaching, designing adequate courses, collaborating with subject specialists, doing research, and evaluating, the ESP practitioner is now required more than ever to possess digital literacy and to keep their skills up-to-date with digital progress. This new profile will enable the ESP instructor to fulfill the multiple roles attributed to them in an ESP setting on the one hand and to meet the students' communicative needs of the digital age on the other. In this respect, they argue that these instruments can "brought new modes of teaching and learning to the surface, including Moodle platforms, Massive Open Online Courses (MOOCs), Google Classroom, Zoom, etc., reshaping ESP teaching and learning environment. Consequently, ESP pedagogy has been profoundly affected by ICT progress" (2023, p. 149).

### The Use of AI in ESP Classroom

Many studies have been conducted on the use of AI-related technologies in English Language Teaching (ELT), in general, and English for Specific Purposes (ESP), in particular, where AE technological tools are assumed to be more effective and beneficial for both teachers and learners as they contribute to developing their deep learning, communicative skills, abilities, linguistic competence, etc. (Prenga, 2020; Kushmar et al, 2022; Chao et al, 2023).

Istrate (2018), for instance, presented her work on Artificial Intelligence and Machine Learning – Future Trends in Teaching ESL and ESP at an international scientific conference on eLearning and Software for Education, which was held in Bucharest. Indeed, she urges the need to adjust e-learning programs to the students' needs. She adds that universities should create artificially intelligent e-learning platforms that are tailored to the needs of the students through the integration of e-learning chatbots. This trend in ESP teaching, according to her,

will place a greater emphasis on the accomplishments of the individual, provide more chances for success in the acquisition of the target language, and allow for one-to-one interaction.

In another research, Zhu (2022) conducted a classroom-based investigation on teaching English to engineering students from the College of Foreign Languages at Jilin Agricultural University. He suggested a B**ack Propagation Neural Network** (BPNN) approach based on the improved Grey Wolf Optimizer (GWO) algorithm. The findings demonstrated that this model is very beneficial for an ESP practitioner to discover his students' learning difficulties. Additionally, it allows for more student-teacher interaction and collaboration. He also found that the improved BPNN method based on the GWO algorithm can evaluate ESP teaching quality more scientifically and adequately in terms of teaching objectives, content, methods, and techniques. It can also offer valuable reference values for further improving the rank of ESP teaching.

Another research carried out regarding the effects of using ChatGPT in the Teaching and Learning of ESP is that of Ahmed *et al.* (2023) from the Cyprus International University and Near East University. They argue that this current AI technological platform uses powerful machine learning to produce text input answers that are remarkably human-like responses. Thus, learners can enhance their English language ability and "perform various natural language processing tasks, including text completion, translation, question answering, and summarizing" (p. 43). They add that this device is a very convenient tool for text generation. ESP instructors, in this respect, will get at their proposal a large dataset of texts depending on their learners' target discourse community such as business, medicine, and technology. This can be achieved by collecting sources from books, articles, magazines, and so on. Furthermore, they go a step further; they believe that ChatGPT can be a prevailing instrument to develop customized grammar and vocabulary courses for ESP learners due to its ability to gather a database of the students' subject-specific language use, in other words, what are the most common linguistic structures and terminology of a particular target setting. These tasks-based activities can be adapted to the students' requirements, language ability, and linguistic background.

*Purpose of study*

There are two principal aims of this current research:

1. To determine whether the ESP teachers' awareness of the significance of using artificial intelligence in their language instruction in different departments of various Algerian institutions in higher education.

2. To explore the role of this AI technological trend in enhancing the status of ESP teaching in the future.

This research highlights the importance of technology-integrated English Language classrooms in general and specialized language courses in particular. It provides the major extensive consideration of the role of the process of Needs Analysis and Identification in fitting the learners' needs and the demands of their digital age. It is hoped that this investigation constitutes a significant contribution to research by reconsidering the profile of ESP practitioners and revising the process of the course and syllabus design.

In accordance with the aforementioned objectives, the subsequent inquiries were addressed:

Q1. Are ESP teachers aware of the significance of using artificial Intelligence in their language classroom?

Q2. How can Artificial Intelligence enhance ESP instruction in the future?

To provide reliable answers to these research questions, it has been hypothesized:

H1. ESP teachers may be aware of the significance of using artificial Intelligence in their language classroom as it may have the potential to bridge the existing gap between learners' target and learning needs and meet the expectations of the global age.

H2. AI may enhance ESP instruction in the future by offering advantages for the teaching and learning process. ESP practitioners may manage their time, and develop their teaching abilities and practices.

*Methodology*

This current investigation is a case study conducted in Algerian higher education institutions in the first semester of the 2023 / 2024 academic year. This type of research is, by definition, a useful tool to explore and describe a phenomenon in context through the administration of one single or mixed-method approach. It has the potential to provide "…a unique example of real people in real situations, enabling readers to understand ideas more clearly than simply by presenting them with abstract theories or principles" (Cohen et al., 2000, p. 181).

It was built on a total number of 40 ESP practitioners from various Algerian higher Education institutions and departments, including eleven Universities and the Higher School of Management, Tlemcen. The simple random sampling of this target population is composed of men and women who teach different types of ESP courses and their instructional experiences range from minimal to extensive level of experience who willingly agreed to take part in this investigation. The table below provides further description of the ESP practitioners' profiles:

**Table 1**
*ESP Teachers' Profile*

| Item | Characteristics | Percentage |
|---|---|---|
| **ESP teachers** | women | 26 = 65% |
| | men | 15 = 35% |
| **ESP Teaching experience** | Less than 5 years | 17 = 42,5 % |
| | From 5 to 10 years | 10 = 25 % |
| | More than 10 years | 13 = 32,5 % |
| **Institution** | Higher School of Management, Tlemcen | 3 = 7,5% |
| | University of Tlemcen | 8 = 20% |
| | University of Ain Temouchent | 4 = 10% |
| | University of Oran | 4 = 10% |
| | University of Tiaret | 4 = 10 % |
| | University of Saida | 2 = 5 % |
| | University of Mascara | 6 = 15% |
| | University of Blida | 2 = 5 % |
| | University of Naama | 4 = 10 % |
| | University of Setif | 2 = 5 % |
| | University of Adrar | 2 = 5 % |
| | University of Biskra | 2 = 5 % |
| **Types of ESP course** | English for Business and Commercial Science | 12 = 30 % |
| | English for Science and Technology | 15 = 37,5 % |
| | English for Social Sciences | 8 = 20% |
| | English for Occupational Purposes | 5 = 12, 5 % |

A web-based questionnaire was administered to 40 ESP practitioners to identify their perceptions on the use of new emerging AI technology in ESP classrooms. This data-gathering instrument is recognized within the realm of educational research as affording the investigator an occasion to "… obtain information about the thoughts, feelings, attitudes, beliefs, values, perceptions, personality, and behavioral intentions of research participants" (Johnson & Christensen, 2014, p. 254). Moreover, the utilization of digital surveys is commonly accepted for its flexibility in being conducted in different formats, its ability to reach a larger sample of participants, its administration and analysis to be

accomplished in a time-efficient manner, and its use of various question types (Balka et al., 2013).

This online questionnaire comprises three distinct sections. The initial part pertains to the information background of ESP teachers. The second one concerns teachers' attitudes towards the use of artificial Intelligence in education. The final rubric is about the advantages of using AI in ESP Classroom. Regarding the protocols employed in the data collection process, it was carried out via Google Forms and distributed to ESP teachers through Uniform Resource Locator (URL) via their private electronic email addresses or teachers' social networking accounts and groups.

*Results*

To align with the objectives of the present investigation and obtain what is known as valid and reliable results in educational research, the researcher selected qualitative and quantitative data analysis to examine the questionnaire as a data-gathering tool. Additionally, the results were subsequently condensed and exhibited under the subsequent categories:

*ESP teachers' awareness of the significance of using artificial Intelligence in their language classroom*

Based on the results derived from the questionnaire as a data gathering tool, the findings have disclosed that ESP teachers, in general, were found to be aware of the significance of using artificial Intelligence in their language classroom. When asked to describe this current trend, most of them were able to define Artificial Intelligence. The majority of the responses stand for the use of technology, applications, and devices to solve human problems. The reported answers have been set out in table 2 below:

**Table 2**
*ESP Teachers' Definitions of AI*

| Statement | Percentage |
|---|---|
| machine learning | 5 = 12,5 % |
| a simulation of human intelligence | 15 = 37,5 % |
| a digital revolution where technology is used to perform tasks | 20 = 50 % |

Additionally, most of the participants (65%) approved the use of AI in their ESP classroom. Furthermore, teachers were required to provide justifications for their answers. The most frequently cited rationales are reported as follows:

- To reach technology.
- To be always updated with nowadays teaching materials and techniques.
- It may be helpful for the teachers in many processes.
- It can be useful for elaborating the syllabus, preparing lessons, and setting adequate objectives.
- It is helpful to assist our teaching practices.
- It helps teachers to gain time and energy using smart tools.
- It provides the advantage of organized information, allowing students to access knowledge from various sources effortlessly.

On the other hand, a minority of them (40%) expressed opposing views where they reported some issues related to the role of the teacher, the absence of human intelligence, and human face-to-face interaction, feelings, and kinesics.

In this respect, one participant commented:

> *[I am] in favor but with restrictions so that it does not go outside scientific ethics. It provides the advantage of organized information, allowing students to access knowledge from various sources effortlessly. However, it limits students' work and creativity.*

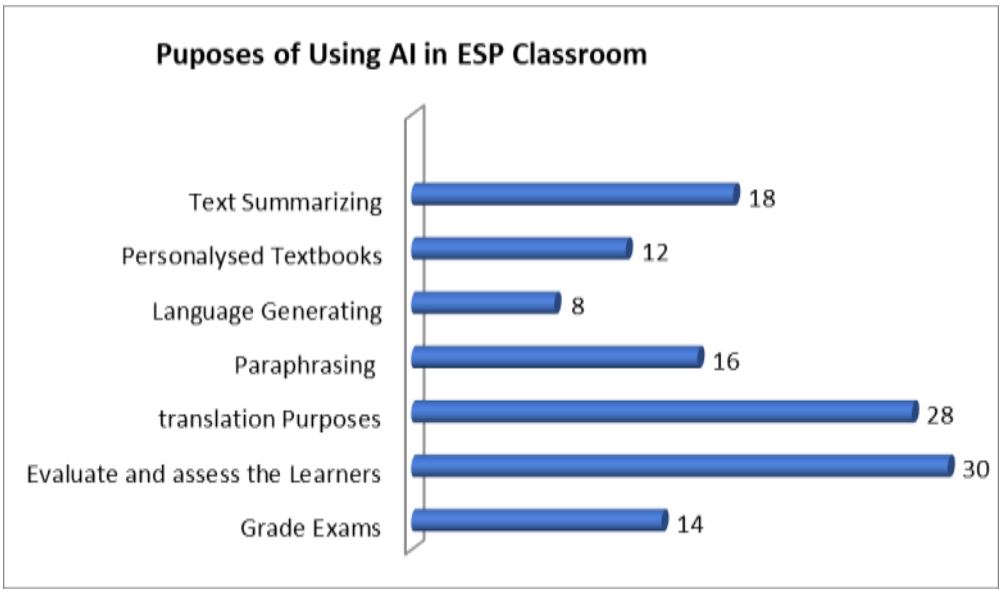
Another informant stated,

> *Yes, because it brings all students together virtually, it makes a long journey short by shortening distances and avoiding an opportunity for everyone to attend from their homes. No, because the reliability of AI is increasing so fast that it can probably replace human beings and eliminate their role as teachers and instructors. For students, it can raise their dependency on it, so there will be no originality and authenticity in research and academia.*

Results also show that teachers encourage their ESP students to use different AI application tools. Chat GPT and Duo Lingo (35%) were claimed at the highest percentage, followed by Language Pro (30%). Rosetta Stone (15%) was placed at the lowest proportion. Additionally, the minority of them did not use any of them.

Further analysis of the data reveals that ESP teachers have different purposes for using AI, as illustrated in Figure 1. The process of Evaluation and assessment of the learners' performance was suggested as the highest percentage (75%), followed by translation Purposes (70%), Text Summarizing (45%), Paraphrasing (40%), and Grade exam (35%). In contrast, personalized textbooks (30%) and language generating (20%) were selected by only a minority of the teachers.

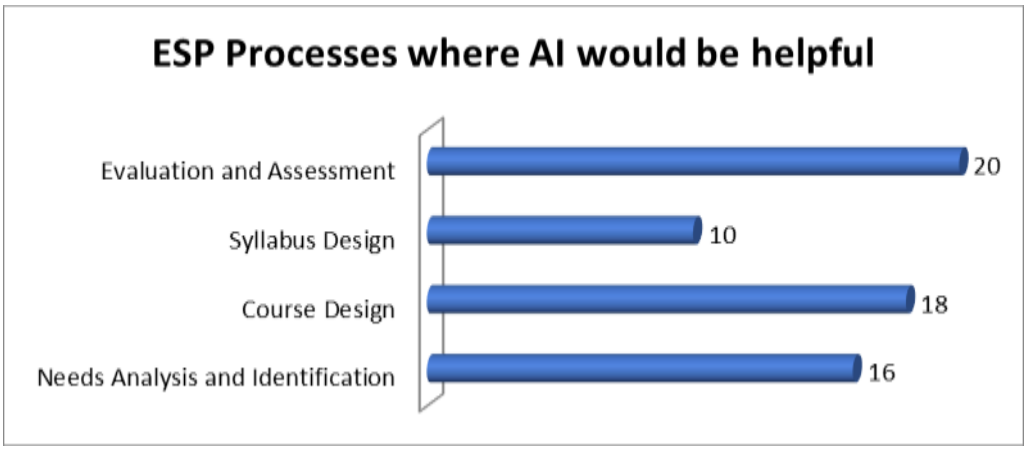
**Figure 1**
*Purposes of Using AI in ESP Classroom*




ENHANCING THE FUTURE OF ESP TEACHING THROUGH AI

To investigate the future of ESP instruction in the light of artificial intelligence, practitioners were required to pinpoint the various processes where this current trend would be very helpful. Results unveiled that **over half of those** surveyed indicated the process of Evaluation and Assessment at the highest rate, 45% agreed on Course Design, 40 % pointed out Needs Analysis and Identification, and less than 30 % proposed Syllabus Design, as seen in Figure 2.

**Figure 2**
*ESP Processes where AI would be very helpful.*



To explore the advantages and disadvantages of using AI in an ESP context, results showed that just about two-thirds of the participants (65%) reported that it would save teachers' time and effort, 4% expressed their disagreement, while the minority (25 %) remained neutral. Around 60% of the ESP practitioners believed that AI technological applications would enable them to undertake the process of Needs Analysis and Identification, the minority of them (15%) did not accept this statement, and 25% were neutral. Another major trend displays a significant proportion of about (85 %) of the answers, which stands for the report of using AI for more time management and course planning. Over half of them suggested that it permits for an easy assessment of learners' tasks and abilities; it enables students to improve their language and academic achievement and enables students to improve their language and academic achievement.

As summarized in the same table 3, results also unveiled that almost 45 % of the teachers believed that AI permits them to adapt the content to the learners' requirements, a minority of them (15 %) disagreed with this idea. Findings also suggested that just under half of those surveyed indicated that AI will enable students to develop their 21st-century skills, such as problem-solving and autonomy; 35 % stated that it enables students to enhance their critical thinking.

**Table 3**

*Advantages of using AI in ESP Context*

| | **Agree** | **Disagree** | **Neutral** |
|---|---|---|---|
| AI will save teachers' time and efforts | 26 = 65% | 4= 10% | 10 = 25 % |
| AI will enable ESP teachers to analyze the learners' needs | **24**= 60 % | **6** = 15 % | **10** = 25 % |
| AI allows for more time management and course planning | **34** = 85 % | **4** = 10 % | **2** = 5 % |
| AI permits an easy assessment of learners' tasks and abilities | **22** =55 % | **6** =15 % | **12** =30 % |
| AI permits to adapt the content to the learners' requirement | **18** =45 % | **6**=15 % | **16**= 40 % |
| AI will enable students to improve their language and academic achievement | **20** =50 % | **10** = 25 % | **10** = 25 % |
| AI will enable students to enhance their critical thinking | **14** = 35 % | **16** = 40 % | **10** = 25 % |
| AI will enable students to develop their 21st century skills such as problem-solving and autonomy | **18** = 45 % | **8** = 20 % | **14** = 35 % |

Teachers were also invited to provide their opinions about the future of ESP in the light of AI. In this respect, they were requested to state if this new technology can enhance their roles. The majority of the responses were very positive; they argue that AI application tools can become a great teacher's aide and supportive device that will enable teachers to inspire and guide students, do better in their language classroom, and provide more opportunities for self-directed learning.

Some felt that it was becoming trendy to study online rather than onsite. The reliance on applications to learn a language, for example, is more effective for better language acquisition. AI will enhance ESP teachers' roles and many others because it gives more importance to the learners' needs and lacks. However, others considered that AI can be a risk for the learners as they will be accustomed to the use of online platforms and social media and they tend always to return back to their smartphones' applications. Face-to-face interaction and a variety of psychological aspects, such as their wants, motivation, and attitudes to learn the language, were also reported to be among the issues that can influence the ESP teaching and learning process.

As demonstrated in Table 4, findings indicated that the majority of the practitioners (80 %) supported the statement that ESP teachers, as well as learners, need to receive technical training to use AE in language classrooms. The overwhelming majority (90 %) endorsed the need to be supported to form partnerships to enhance their skills. Additionally, over two-thirds of them (65%) expressed a desire to be funded to purchase AI applications and tools.

**Table 4**

*Recommendations for Using AI in ESP Classroom*

| | Agree | Disagree | Neutral |
|---|---|---|---|
| ESP teachers, as well as learners, need to receive technical training to use AE in language classroom | 32= 80 % | 00=00% | 8=20 % |
| ESP teachers, as well as learners, need to be funded to purchase AI applications and tools | 26=65 % | 6=15 % | 8=20 % |
| ESP teachers, as well as learners, need to be supported to form partnerships to enhance their skills | 36=90 % | 00=00 % | 4=20 % |
| ESP Teachers and learners should develop a positive attitude towards technology-integrated learning in general and AI in particular | 30=75 % | 00=00 % | 10=25 % |

*Discussion*

The starting objective of this current investigation is to determine whether the ESP teachers are aware of the importance of using artificial Intelligence in their language teaching. The most obvious finding to emerge from the analysis is that practitioners, who are in charge of teaching different types of ESP, encouraged their learners to use a variety of AI to fit the digital revolution, be up-to-date with the current technology, meet the learners' needs and wants, and assist their teaching practices. This finding broadly supports the work of other studies in this area linking ESP to technology (Constantinou & Papadima-Sophocleous, 2020; Nickerson & Planken, 2016) who found that it is necessary to integrate different forms of technologies as well as different media and technological learning tools to fit the students' linguistic requirements and fulfill the needs of their global discourse community.

Moreover, the most compelling finding was that the overwhelming majority of teachers were conscious of the significance of AI in the process of Evaluation and assessment, course design, needs analysis and Identification. These identification results are in accord with recent studies indicating that Education must be adapted in one way or another to be consistent with the ever-changing social world imposed by the Net Generation (Jacobs & Nader-Grosbois, 2003). In light of these results, one can say that the first hypothesis is confirmed with states that ESP teachers may be aware of the significance of using artificial Intelligence in their language classroom as it may have the potential to bridge the existing gap between learners' target and learning needs and meet the expectations of the global age.

The second objective of this study is to explore the role of this AI technological trend in enhancing the status of ESP teaching in the future. Results unveiled that the vast majority of the teachers believed that AI could be a toolset in improving the teaching and learning process due to the various benefits it would offer for both instructors and learners. The bulk of answers stands for the idea of saving teachers' time and effort and analyzing the learners' needs. Over half of them believed that AI would permit an easy assessment of learners' tasks and abilities and enable students to improve their language and academic achievement. These results corroborate the findings of a great deal of the previous work in Ahmed *et al., 2023;* Cardona *et al.* 2023; Istrate, 2018; Kushmar et al., 2022; Rebolledo & González, 2023).

However, this study has been unable to demonstrate that AI can be used as a tool to adapt and personalized the content to the learners' requirements, develop

their 21st-century skills such as problem-solving and autonomy and enhance their critical thinking (Chen, Zou, Xie, & Cheng, 2021; Kessler, 2018). These surprising findings could have been generated by the absence of face-to-face teaching and human interaction, the lack of technical training, practitioners' negative attitudes towards the use of these new technologies in their language classroom, and its challenges to diminish their role as needs analyzer, course designer, and materials provider. Thus, in the light of these results, one can say that the second hypothesis, which states that AI may enhance ESP instruction in the future by offering advantages for the teaching and learning process, is also confirmed. ESP practitioners may manage their time and develop their teaching abilities and practices.

*Conclusion*

This present case study was based on 40 ESP teachers from different Algerian Higher Educational Institutions. Its primary objective was to explore the ESP practitioners' awareness of the significance of using artificial Intelligence in their language instruction and to investigate the role of this technological learning trend in enhancing the status of ESP teaching in the future. One of the more significant findings to emerge from this study is that practitioners felt the necessity to integrate different forms of technologies as well as different media and technological tools to fit the students' linguistic requirements and fulfill the needs of their global discourse community. This study has found that they were generally conscious about the significance of using AI in the process of Evaluation and assessment, course design, needs analysis and Identification. This study has also identified that AI can be used as a toolset in improving the teaching and learning process for the numerous benefits it would offer for both instructors and learners.

The results of this study indicate that teaching English for Specific Purposes is increasingly providing too much concern to fit the learners' academic and professional requirements. Considering this fact, Algeria, like any other country, should exert considerable effort and take the lead in implementing and designing suitable courses that are intended to bridge the gap between fieldwork and the demands of the students' virtual age. Therefore, introducing AI learning tools might be a very important key in this respect if the Algerian Ministry of Higher Education and Scientific Research might provide the necessary infrastructure by purchasing AI tools and applications and investing in training human assets to develop the ESP teachers' and learners' computing skills and enhance the teaching and learning practices.

The evidence from this study suggests that AI technologies are likely to be a useful tool to get access to texts specific to the students' discourse community. It might also provide an opportunity to personalize textbooks, generate terminology and grammar tasks, use a variety of interactive learning teaching resources, and provide corrective feedback. In this respect, AI can be used as a supportive tool to save teachers' efforts and assist and enhance their role but never diminish their responsibilities as ESP practitioners.

This current investigation was limited in terms of the small size of the sample population, the choice of a questionnaire as a data-gathering instrument, and the time constraint to reach the entire population. As a result, further studies may include a large number of ESP learners and teachers to expand the scope of this study and use additional research tools such as interviews and classroom observation to better scrutinize the role of AI in developing teaching techniques, strategies, practices, and enhancing learners' 21st-century skills.

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