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Knowledge construction in blended learning and its impact on students' academic motivation and learning outcomes

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Background: Blended learning combines the strengths of online and face-to-face education to cater to students' varying needs and preferences. However, in blended learning environments, learners often encounter challenges stemming from the lack of support and guidance compared to traditional face-to-face teaching methods. Computer-Integrated Learning Assistance (CILA), which utilizes AI technologies, provides real-time support and guidance to learners in this context.

Objective: The current study analyzed the role of technological knowledge construction in blended learning and how it impacts students' academic motivation and learning outcomes.

Method: The study is qualitative in nature and participants were recruited using a purposive sampling technique. Ten university professors were selected for the study. Qualitative data collection was performed using a semi-structured interview guide. The collected data were analyzed utilizing the NVivo 13 software.

Result: The study findings suggest that blended learning is a flexible way of learning which saves money and time as students can easily access their course materials. Additionally, blended learning increases students' learning motivation, facilitates both place and peace of learning, and has the potential to enhance student learning outcomes to improve their thinking ability.

Conclusion: The use of blended learning helps with evaluation and continuous improvement. Based on the study findings, it is concluded that teachers can guide learners through direct interaction in classes and reinforce their understanding of the subject matter through the interaction, accessibility, and flexibility of multi-media and online-created environments in blended courses.

KEYWORDS

blended learning, motivation, challenges, learning outcomes, impact

Introduction

The education sector has undergone several transformations in recent years, mainly due to the emergence of new teaching methods and the digitization of textbooks. The COVID-19 pandemic highlighted the need for more effective and flexible methods of teaching, that make use of online resources and in-person instruction. This new approach to learning allows students to access a wide variety of educational materials and improve their engagement with the learning content. As the evolving role of educators in supporting

the use of self-directed education necessitates the need for more efficacious resources and tools, students increasingly require guidance and support (Rasheed et al., 2020; Vanslambrouck et al., 2019).

The current education landscape necessitates a deep understanding of how learners engage with the material and regulate their learning processes. In response to this need, there is a growing interest in leveraging artificial intelligence (AI) to augment traditional educational methods. This research proposes a novel approach by integrating AI, specifically the ChatGPT language model, into blended learning environments to enhance learners' knowledge construction and self-regulation abilities (Afzaal et al., 2024; Kintu et al., 2017). Blended learning, which combines traditional face-to-face instruction with online components, offers a flexible and personalized approach to education. However, effectively managing and optimizing this blend requires tools which can adapt to individual learners' needs and preferences (Bashir et al., 2025; Machumu et al., 2018).

Computer-Integrated Learning Assistance (CILA) utilizes AI technologies such as ChatGPT to provide real-time support and guidance to learners. By interacting with ChatGPT, students can receive immediate feedback, explanations, and additional resources tailored to their learning goals and preferences (Wu et al., 2024; Younas et al., 2025). Self-regulated learning encompasses a range of cognitive, metacognitive, and motivational processes through which learners actively monitor, control, and regulate their learning. The CILA platform provides users with real-time and contextual information tailored to their needs. This makes it an ideal tool for students seeking answers to questions in a blended learning setting. Self-regulation plays a pivotal role in academic success within blended learning environments, demanding a higher degree of learner autonomy than traditional teaching approaches (Huang et al., 2023). It has shown that regulation is essential in guiding the dynamic development of blended learning. AI technologies are transforming teaching and learning in the digital age. By leveraging ChatGPT's capabilities, educators can create more adaptive and responsive learning environments that empower students to thrive in an ever-evolving educational landscape (Sánchez-Ruiz et al., 2023).

Blended learning combines the strengths of online and face-to-face education to cater to students' varying needs and preferences. It aims to improve their learning satisfaction and efficiency (Rasheed et al., 2021). Due to the emergence of the COVID-19 pandemic and the challenges that it presented to traditional face-to-face teaching methods, blended learning has gained widespread popularity (Kaffenberger, 2021; Pokhrel and Chhetri, 2021). This instructional model aims to provide students with a flexible and comprehensive learning experience. It combines traditional methods with online learning tools (Hrastinski, 2019).

Literature review

Research suggests that implementing blended learning can yield positive outcomes for students. For instance, a study conducted by Kundu et al. (2021) in a fourth-grade classroom in India found that after 9 weeks of blended learning instruction, students exhibited significantly increased levels of learning engagement. Additionally, educators well-versed in blended learning pedagogy can effectively promote active learning among students, further enhancing this instructional approach's efficacy (Martinez et al., 2019; Imran et al., 2024). While blended learning empowers students to choose their learning methods and pace, and provides access to various learning resources, this autonomy can also pose difficulties. Without adequate self-regulation skills, students may struggle to effectively manage their learning and become overwhelmed or disengaged (Ruth, 2022). Despite the evident benefits of blended learning, its implementation within educational contexts is not without its challenges. One significant challenge is students' inability to effectively self-regulate their learning processes (Vo et al., 2020; Zhou et al., 2022).

Technological factors present another set of challenges in blended learning environments. Students may face technological literacy and competency barriers, which can hinder their ability to effectively navigate online learning platforms and utilize digital tools (Huang, 2021; Wang et al., 2025). Additionally, feelings of isolation stemming from reduced face-to-face interaction, concerns regarding the sufficiency of available technology, and the complexity of technological systems can further exacerbate students' challenges in blended learning settings (Bruggeman et al., 2021; Imran et al., 2025). Self-regulation challenges arise in blended learning environments due to the considerable autonomy afforded to students. With the flexibility to manage their schedules, students may succumb to distractions and procrastination, reducing the time dedicated to coursework and hindering their progress (Joubert et al., 2020).

Technological literacy and competency challenges manifest as students grapple with mastering the information and communication technology (ICT) tools integral to blended learning. The reliance on these tools necessitates a swift acquisition of digital skills, which some students may struggle to attain, impacting their ability to fully engage with the course material (Kung-Teck et al., 2020; Younas and Dong, 2024). Student isolation challenges emerge particularly in synchronous blended instruction settings, where students may experience feelings of disconnection and lack of motivation. This sense of isolation can impede their willingness to participate in class activities and submit assignments promptly. It may even contribute to heightened levels of anxiety, further hindering their academic performance (Castro-Rodríguez et al., 2021).

Technological sufficiency challenges highlight the importance of ensuring widespread access to the necessary hardware and software for blended instruction. Without adequate technological resources, students may encounter barriers to fully participating in online learning activities, limiting their ability to benefit from the blended learning experience (Wenzhi et al., 2022). Technological complexity challenges arise from the diverse array of learning programs utilized in blended learning environments. The varying difficulty levels associated with these programs can pose a significant learning curve for students, requiring additional time and effort to effectively navigate online resources, potentially detracting from their focus on course content

and learning outcomes (Yin and Yuan, 2021; Younas et al., 2022).

The rapid emergence and evolution of ICT tools have helped to address challenges related to student isolation and technology integration (Kardipah and Wibawa, 2020; Montgomery et al., 2019). The autonomy granted to students in blended learning is a central feature of this type of education, but it also highlights the challenge of self-regulation. Adjusting learning motivation to sustain engagement is crucial. The performance phase involves active participation in learning activities, with learners continuously monitoring and adjusting their strategies to ensure goal attainment. The final phase, self-reflection, necessitates a comprehensive review and evaluation of learning effectiveness and outcomes to facilitate further learning and knowledge acquisition (Grønlien et al., 2021).

As defined, self-regulation encompasses learners' abilities to independently control, monitor, and regulate their learning process to achieve their educational objectives (Pintrich, 2000). The most widely recognized framework for self-regulation delineates three distinct phases: forethought, performance, and self-reflection (Joanna, 2009). While Zimmerman's model forms the cornerstone of understanding self-regulated learning, complementary viewpoints from other models enrich our comprehension of this multifaceted process (Zimmerman, 2000). The view of self-regulated learning as a sequence of iterative cycles highlights its cyclical and adaptable nature (Winne, 2011). A previous study underscores the interplay between motivation and contextual factors, focusing on metacognitive elements and accentuating the collaborative aspect of learning (Efklides, 2011). Maintaining effective self-regulation involves keeping oneself motivated, engaged, and feeling good about oneself (Noor et al., 2022).

Blended learning environments are often less structured and provide less guidance and support than traditional face-to-face classes. Effective self-regulation is crucial (Kizilcec et al., 2017). Studies have highlighted the benefits of self-regulation in blended learning contexts, with self-regulation behaviors positively influencing dropout rates, and academic performance further demonstrating the efficacy of self-regulation scaffolding in enhancing learner engagement and academic performance in blended learning environments (Moreno-Marcos et al., 2020).

The rationale of the study

In blended learning environments, learners often encounter challenges stemming from the lack of support and guidance compared to traditional face-to-face teaching methods. These difficulties can result in decreased motivation, engagement, self-efficacy, and ultimately, academic failure (Kim et al., 2019). To address these challenges, students frequently use the Google search engine to find solutions (Isda et al., 2021). However, while Google can assist, the scattered and disorganized nature of the retrieved information often disrupts the learning process, impeding their self-regulation process (Carlini et al., 2021). The current study therefore analyzed the role of technological knowledge construction in blended learning and how it impacts students' academic motivation and learning outcomes.

Methodology

Sampling

In this study, we conducted interviews with university teachers. The purposive sampling technique was used to select 10 teachers from four universities in Beijing city of China for qualitative data collection by using semi-structured interviews. Four universities were chosen as population and Chinese Professors who were teaching to Master and Ph.D level classes were selected for the study. The selection criteria of the participants included their experience in using blended learning, and their teaching in English and foreign languages schools of different universities. All required teachers were approached via email and confirmed their willingness to participate in this study. As shown in Figure 1 there were five male teachers (50%), and five female teachers (50%) who participated in this study, indicating that the overall participation of each gender was equal.

Data collection tool and process

To gather qualitative data, we employed the semi-structured interviewing strategy (Sotiriadou et al., 2014) which is a way to collect qualitative data whereby the researcher asks a series of planned but open-ended questions (Figure 2). Semi-structured interviews are better for collecting qualitative data because they are more flexible. An interview guide could include a set of very specific, well-thought-out questions, or it could just be a list of topics to talk about and simple plan can help make sure that all important topics (i.e., research questions) are covered. The questions were designed to examine knowledge construction in blended learning and its impact on student motivation and learning outcomes. The guide helped the interviewer stay within the limits of the study while also delving deeper into the issues that were raised. Data were collected from November to December 2023 via semi-structured interviews using the interview guide (Figure 3).

Data analysis

This study employed a combination of text analysis and descriptive analysis techniques. Both of these methodologies were integrated to comprehensively address the research objectives (Tang, 2023). We conducted content analysis of the interview data using the NVivo 13 software to analyze participants' responses and discern various themes. The outcomes unveiled numerous advantages of online learning, extracted through word frequency analysis. Key terms such as blended learning, online learning, students, outcomes, instruction, environment, technology, and infrastructure emerged. Additionally, the data underscored specific challenges. A word frequency query enhanced data comprehension, leading to the creation of a word cloud, as can be seen in *Word Cloud*. This visual representation illustrates the frequency of specific words used by participants during the interviews, with font size indicating their significance. Larger fonts denote higher occurrence in the text. Word clouds serve as valuable tools for
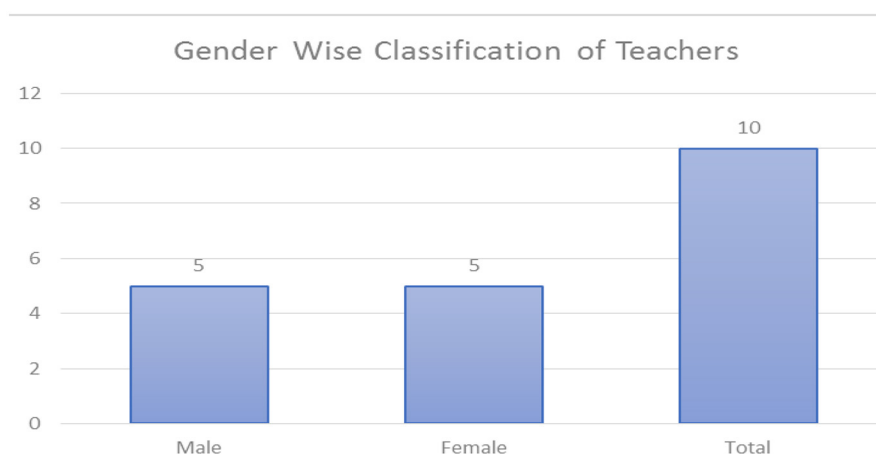
FIGURE 1
Core concept of blended learning.

FIGURE 2
Methodology.
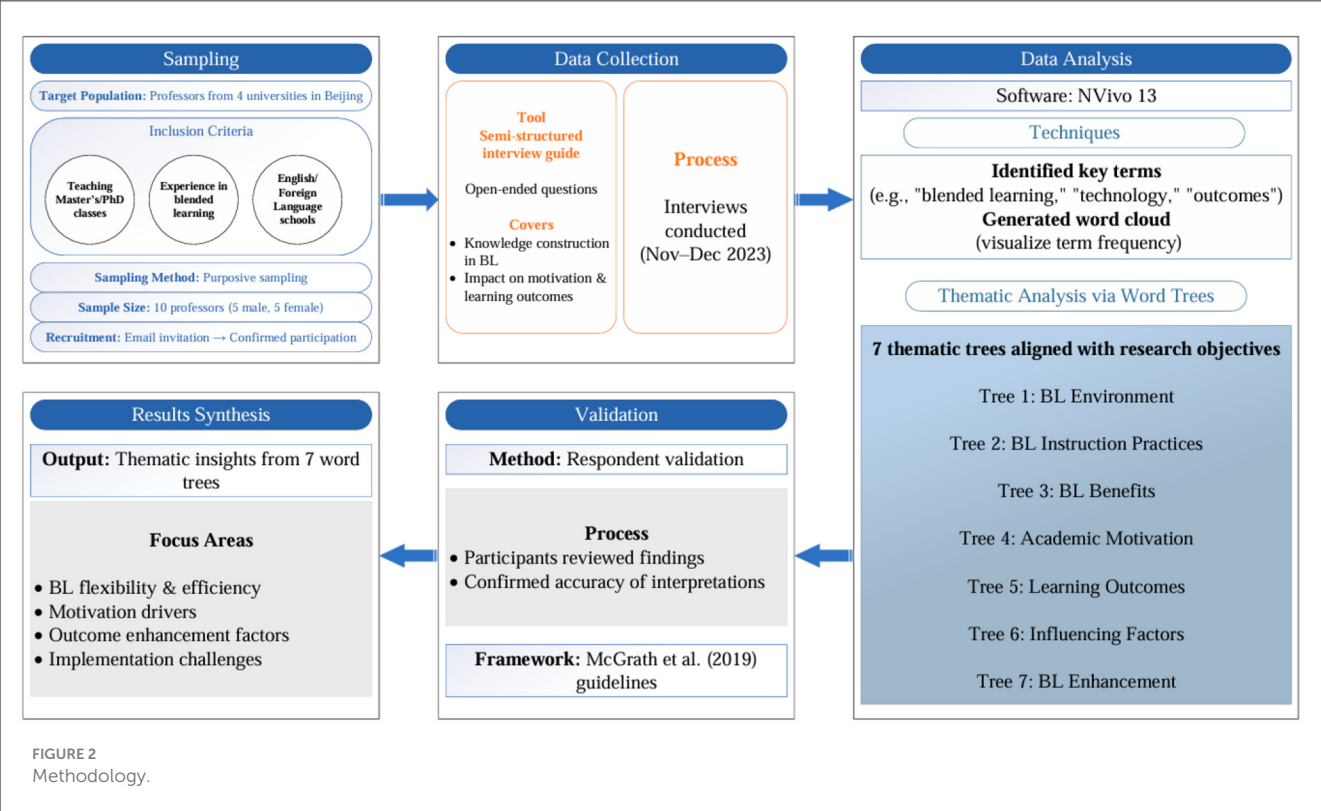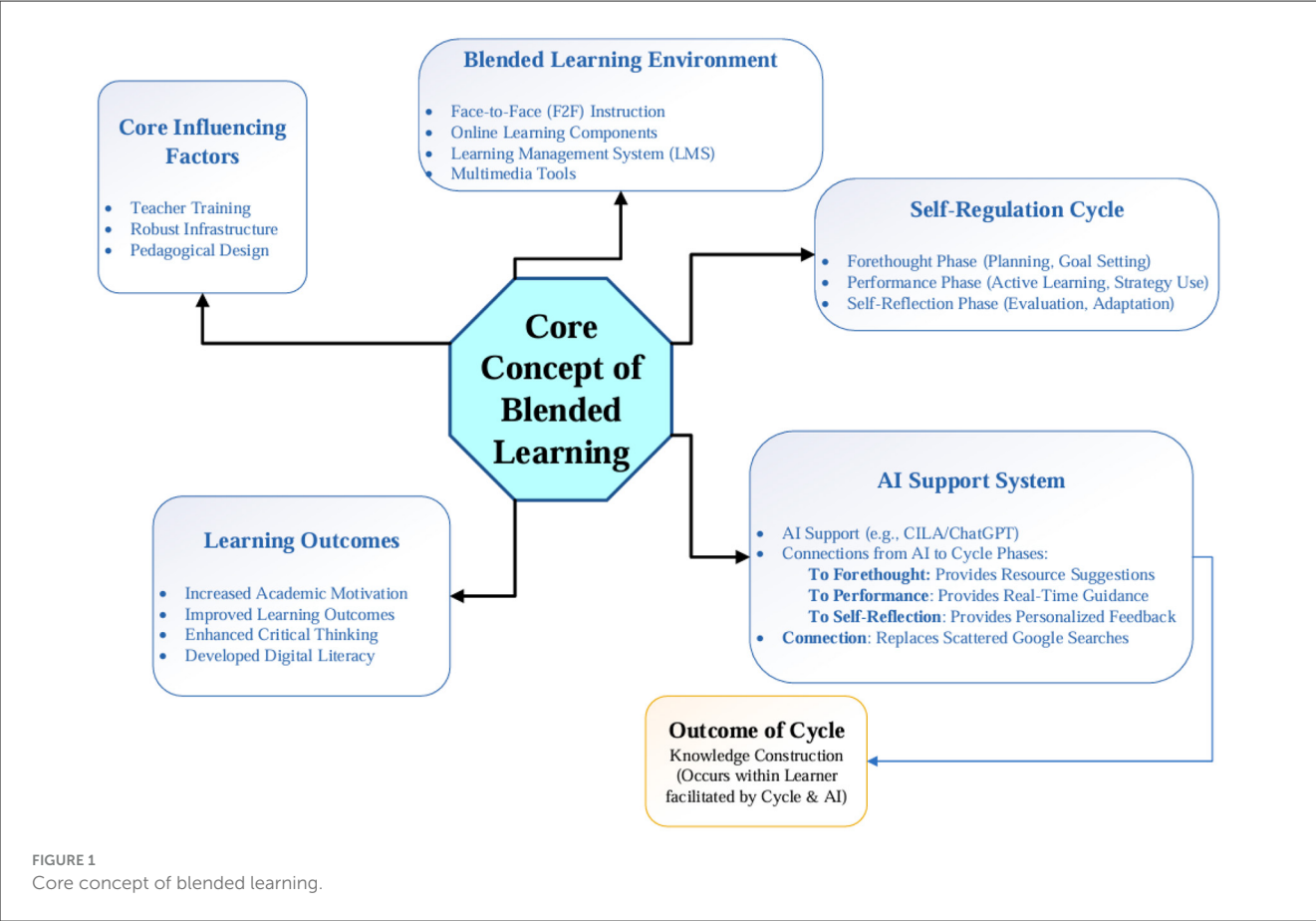
FIGURE 3
Gender-wise classification of teachers.

succinctly summarizing the most frequent words within a dataset, providing quick visual insights.

Validation/quality check

To verify data quality and validity, we used "respondent validation," which involves checking in with research participants to see whether the results reflect their views. We followed the guidelines for qualitative research interviews proposed by McGrath et al. (2019).

Data analysis and results

The analysis process involved two key methodologies; word clouds and word trees, which were generated utilizing NVivo 13 (Azeem et al., 2012) (Figure 4). The analysis focused on investigating various aspects of blended learning, addressing the study objective. Word trees, generated through text search queries, facilitated a deeper exploration of the relationships between words and phrases (Johnston, 2006). These trees allowed us to trace the connections and contexts surrounding critical concepts in the context of blended learning. Each tree was aligned with one of the seven research questions, contributing to a comprehensive understanding of the subject.

Tree 1: the blended learning environment

Tree 1 reflects the main theme of the study which is blended learning (Figure 5). It depicts the complete picture of the study based on blended learning, which is also known as technology-mediated learning. It contributes to the betterment of the education system by providing teacher training, support access and faculty development. The data suggest that blended learning is a flexible way of learning which saves money and time. Encouraging the use of blended learning helps with evaluation and

continuous improvement. Students can easily access their course materials. Blended learning provides an environment of research and evaluation, and it affects students positively. It is flexible, providing both online and offline modes of learning. It enhances the students' interest in learning by providing tools and improving their thinking. Blended learning often incorporates interaction and multimedia for active and enjoyable learning. Most universities use a learning management system (LMS) for better and updated communication between students and the institution. Blended learning has gained significant popularity in academia because it provides tools for tracking learners' performance, which can lead the institution toward improvement.

Tree 2: blended instruction practices

Tree 2 suggests that blended learning plays a vital role in enhancing the modes of instruction such as online instruction, face to face instruction and mixed mode instruction (Figure 6). Blended learning is known as a technology-mediated approach and is a combination of online and face-to face-instruction. It offers online resources which help to reinforce the technology-mediated instruction and web-based instruction enhanced with digital resources. Therefore, the instructions based on blended learning combine the benefits of a traditional instruction system with an online learning system, with flexibility and interactivity.

Tree 3: benefits of blended learning

Tree 3 illustrates the benefits of blended learning (Figure 7). It is visible from the word tree that blended learning helps students' learning motivating and facilitates both place and peace of learning. It also provides support to both faculty and students due to its flexibility. It is therefore a very effective, time and money saving learning approach.

FIGURE 4
Word cloud of the most frequently used words in the interviews.

Tree 4: academic motivation

Tree 4 portrays that blended learning often incorporates an interactive approach which positively impacts students' academic motivation (Figure 8). In short it affects student motivation because it is more convenient for students. It has the potential to foster student motivation by providing a flexible, engaging form of active learning, but student motivation can vary depending on the

individual. Considering this word tree, we can say that blended learning plays a vital role in student academic motivation.

Tree 5: learning outcomes

Tree 5 focuses on learning outcomes based on blended learning (Figure 9). Blended learning is a technique which aims
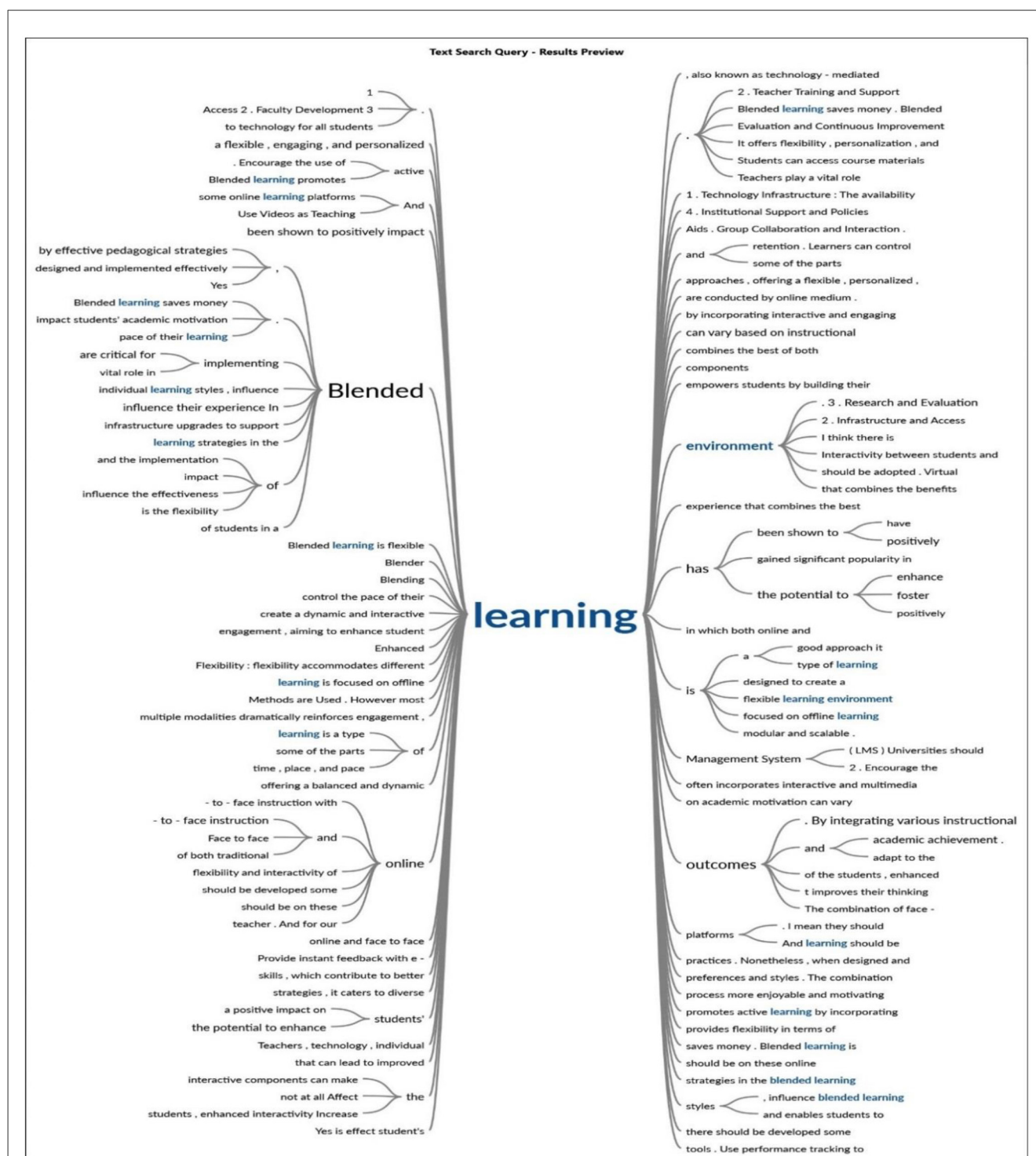
FIGURE 5
Tree 1: the blended learning environment.

to enhance student learning outcomes by integrating various instructional strategies. It can lead to improved learning outcomes and academic achievement. As we can see in the word tree, blended learning positively impacts students' learning outcomes

and enhances interactivity. Blended learning has the potential to enhance student learning outcomes by improving their thinking ability. The combination of face-to-face and online learning has a positive impact on student learning outcomes.
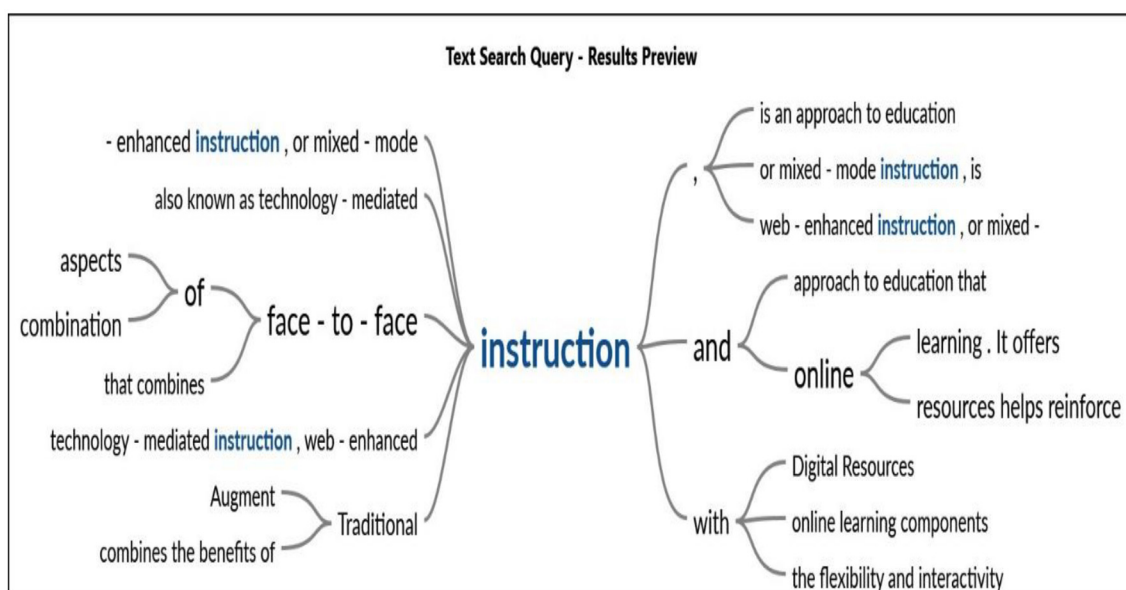
FIGURE 6
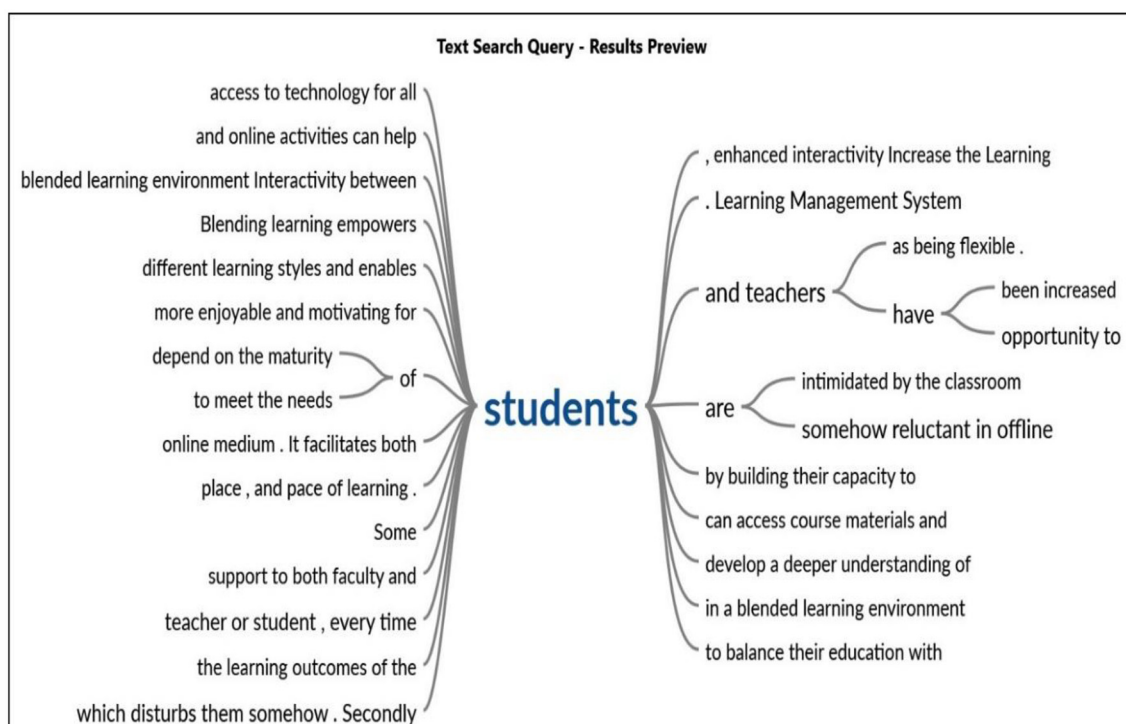Tree 2: blended instruction practices.

FIGURE 7
Tree 3: benefits of blended learning.

Tree 6: factors influencing blended learning

Word tree 6 is related to the factors that affect blended learning (Figure 10). The results show that faculty development should be arranged to enhance blended learning. Mediated instruction, web-enhanced instruction, and individual learning styles all influence blended learning. Access to devices such as infrastructure upgrades can also influence blended learning. Furthermore, the availability
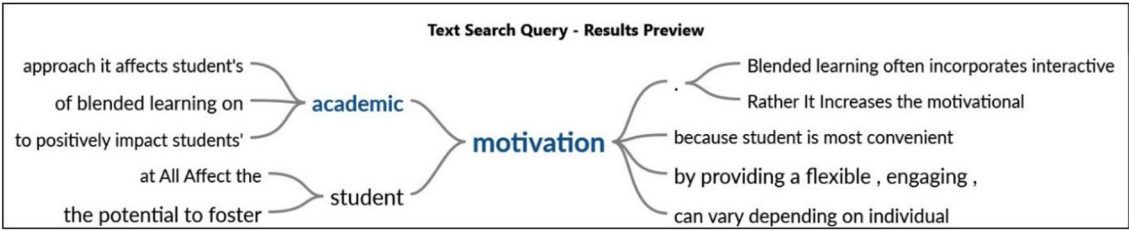
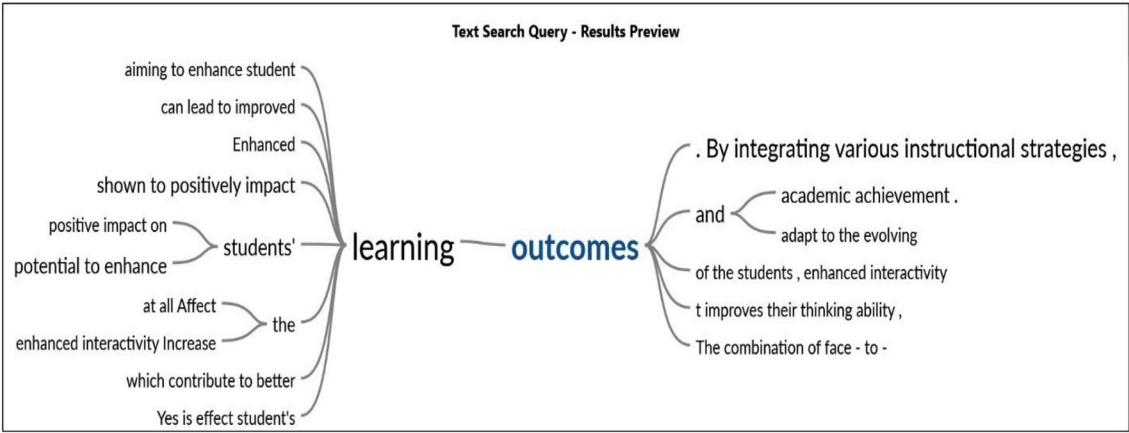**FIGURE 8**
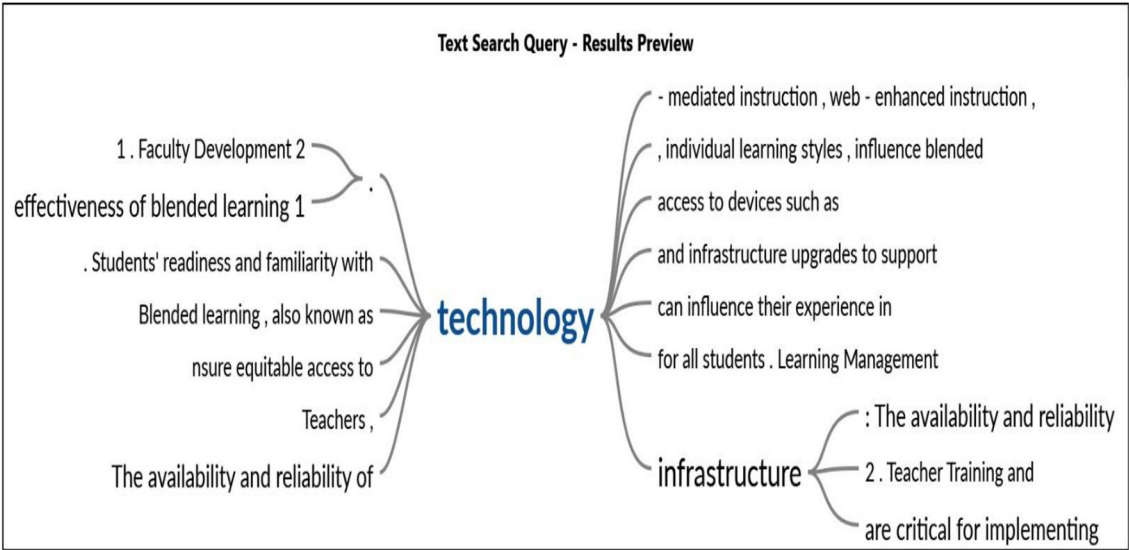Tree 4: academic motivation.

FIGURE 9
Tree 5: learning outcomes.

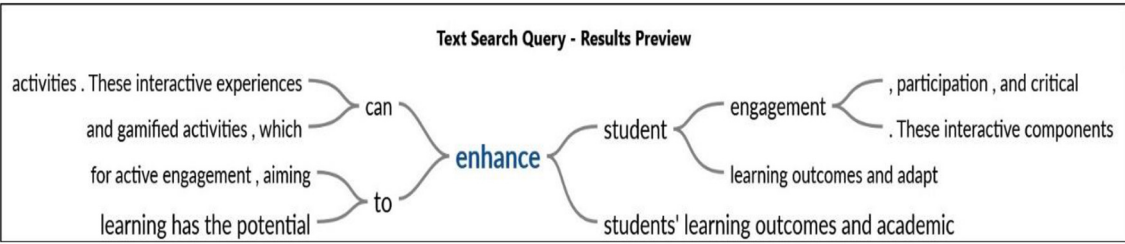**FIGURE 10**
Tree 6: factors influencing blended learning.

FIGURE 11
Tree 7: enhancement of blended learning.

FIGURE 12
Student related challenges and disadvantages.

and reliability of infrastructure and teacher training are critical for implementing blended learning.

Tree 7: enhancement of blended learning

Word tree 7 suggests that interactive experiences can enhance student engagement, participation and critical thinking (Figure 11). These interactive components and gamified activities can enhance student learning outcomes, so we can conclude that blended learning has the potential to enhance student learning outcomes and academic achievement by engaging them in activities such as games.

Discussion

The perspectives depend mainly on the teachers' experiences with the three types of education, before the COVID-19 breakout,

during COVID-19 quarantine, or after post-COVID-19 return to the academic institutions after the emergence of vaccinations (de Moura et al., 2021; Singh et al., 2021). The data analysis of this study showed that blended learning was significantly more preferable to the participants than either face-to-face education or online education on their own.

Blended education

Blended learning provides the opportunity to create a multi-context environment that leads to an interesting setting for both teachers and students (Ustun and Tracey, 2020). Blended learning helps teachers to have control over the learning process, including the content and the materials. Blended learning creates an interesting, effective, and motivating environment for both learners and teachers with the help of various multi-media, internet sources, creative planning, and careful materials design by teachers.

FIGURE 13
Teacher related challenges and disadvantages.

Several studies agree with this finding that shows the effectiveness of blended learning in terms of enhancing the learning process (Monk et al., 2020; Christine, 2020). We found that blended learning has productive and flexible factors as teachers can give feedback both inside and outside the classroom. Therefore, a blended learning environment helps learners to be less stressed and helps them perform better in understanding and learning in EFL courses (Aysel, 2014).

The significant part of blended learning is that teachers can guide learners through direct interaction in class and reinforce their understanding of the subject matter through the interaction, accessibility, and flexibility of multi-media and online-created environments of the course (Behjat et al., 2011). The data analysis of this study showed that blended learning can be beneficial for teaching all the EFL courses unlike online learning which has been shown to be effective for teaching courses with a communicative nature, but not as productive for teaching some writing, practical, and fieldwork courses that require more training and practice (Bueno-Alastuey and López Pérez, 2014; Park and Shea, 2020).

After experiencing full online education during the beginning of the COVID-19 breakout, the participating teachers found after the students' returned to face-to-face classes, their performance was negatively affected due to their poor writing skills. Therefore, this study supports the fact that blended learning is a more appropriate option to help students, and teachers also have a positive attitude toward the usefulness and practicality of blended learning for developing learners' skills. This is consistent with other studies' positive feedback that blended learning helps enhance students' achievements (Qutieshat et al., 2020).

Advantages of blended learning

In the modern age of smart technology and new language software programs that help develop the language learning skills of L2 learners, analysis of the data in this study and in several previous studies (Al-Qatawneh et al., 2020; Shi et al., 2021) indicated that there are undeniable advantages of fully online education for both teachers and learners in the ESL context; online education was found to be positive and effective. With the help of online facilities, teachers can present and provide high-quality, interesting, and authentic resources. Previous studies support the fact that online education helps to improve the communication (speaking) skills of English learners (Liu et al., 2017; Younas et al., 2024). The essential and effective aspects of fully online education are most obvious in remote distance learning environments and critical circumstances such as the spread of the COVID-19 pandemic (Bouilheres et al., 2020). The findings of this study showed that the teachers had a positive attitude toward full online education as it helps evaluate students quickly and efficiently without the physical presence of the teacher and the learners. The learners preferred online education as they were able to receive help from their peers and the resources during the assessment tasks (Sentürk, 2021).

Challenges and disadvantages

The data analysis showed that we cannot depend on online education fully engaging students in learning the subject matter and language skills. Teachers found it difficult to be always teaching in an online environment (Kumar et al., 2020). The majority of participants believed that full online education is not useful for practical fields and subjects, as they need to implement and conduct experiments and practical research. Teachers act as facilitators in the online teaching process where being just a facilitator is not quite enough, especially for learners with a low level of L2 proficiency and less motivation to learn the L2 (Figure 12).

The participants explained that students receive less chance of feedback from their peers in the online classroom activities and from their teachers compared to in face-to-face classes. The

challenges of fully online classes could be due to technical issues such as internet distractions in some areas. Online classrooms can be boring for teachers and learners as face-to-face interaction creates effective discussions (Thai et al., 2020).

When meeting students after the fully online classrooms during the COVID-19 lockdown, the teachers found that online learning negatively affected their ESL writing skills and their spelling competence (Wang et al., 2021; Younas et al., 2023). Moreover, the participants believed that it is difficult to achieve all the learning outcomes in fully online classes as some language skills are affected and the nature of some courses does not support the online classroom teaching approach (Islam et al., 2022).

Although many teachers still believe that face-to-face teaching is a useful approach for learners and teachers, depending only on face-to-face education may lead to some challenges and problems in the future (Figure 13). Depending to a great extent on face-to-face education may lead to less awareness of technology advancements for teachers. Face-to-face classes make teachers aware of the proficiency level of the learners and their content knowledge.

Conclusion

The results showed that the majority of the university teachers who participated in this study had a strong understanding of blended learning environments. The majority agreed that blended learning has several benefits such as flexibility, self-learning experience, active participation and engagement, free online resources, access to diverse online material, enhanced communication, cost-effectiveness, and preparation of students for digital skills. The majority of teachers also agreed that blended learning increases academic motivation. Interactive online components, multimedia tools, and technology-based activities make learning interesting. Most of the teachers agreed that blended learning improves students' academic performance and learning outcomes. The majority of the teachers also indicated several important factors that affect blended learning. Based on the findings of this research, it is recommended that suitable steps be taken to increase the efficacy of blended learning. These steps include enhancing blended learning infrastructure and environments, providing training for instructors, and reducing factors that impact blended learning.

Research limitations

Although this research contributes to our understanding of the relationship between blended learning, knowledge construction and academic motivation and learning outcomes, it is not without its limitations. The findings are limited by the fact that they are drawn from a relatively small number of university professors (ten), so the generalizability of the findings is in doubt, and only instructors' perspectives are considered, thus ignoring students' opinions that are just as important. Additionally, data are based on self-reported and not objectively documented data reporting. The qualitative approach, though appropriate for illuminating ideas, would be enhanced with the triangulation of the quantitative data

or student responses in future work to bolster the reliability and generalizability of the findings.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the study was approved by the Ethical Committee review board of Shenzhen Technology University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

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