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A Systematic Review on the Improving Strategies and Influencing Factors of Vocational Students' Learning Engagement in Blended Teaching Environment

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Abstract. Blended teaching (BT), which combines traditional face-to-face instruction with online components, has become an inevitable trend in vocational education, especially for its potential to offer flexibility, simulation of real working scenarios and hands-on training. Students' learning engagement is regarded as a critical factor for BT's success. Despite progress, theoretical gaps remain, particularly in the influencing mechanisms and strategies for enhancing vocational students' learning engagement in BT contexts. This systematic review aims to fill this gap and provide implications for future BT practices. Sourced from three databases (Web of Science, SCOPUS, and CNKI) and complying with the PRISMA checklist, 38 studies regarding vocational students' learning engagement in BT contexts from 2014 to 2024 were reviewed looking at research features, BT techniques, influencing factors and improving strategies. Findings showed that technological applications and learning management systems (LMS), gamification, flipped classrooms and MOOCs are predominant approaches

in BT. In addition, it is a well-designed teaching strategy and cohesive learning community that enhances students' learning engagement. Besides, individual factors such as curiosity, academic self-efficacy, and career expectations also affect students' learning engagement. This study also provides evidence-based strategies for enhancing vocational students' learning engagement for researchers and practitioners.

Keywords: Systematic review; Blended teaching; Learning engagement; Improving Strategies; Influencing factors

1. Introduction

Students' learning engagement has been regarded as the "holy grail of learning" (Sinatra et al., 2015). It has been linked to important outcomes such as learning satisfaction (Kintu et al., 2017), academic performance, and career maturity in both higher and vocational education (Bonafini et al., 2017; Huang & Wang, 2023; Sanjeev & Natrajan, 2019). Given that, vocational education is specifically practice-oriented (Bliuc et al., 2012; Duman & Gencel, 2023), which attaches great importance to professional knowledge, skills, and hands-on experience in various social and economic areas. Thus, developing and maintaining students' actual learning engagement is one of the vital considerations for educators (Mustapa et al., 2015). It is worth noting that students' learning engagement is presumed to be malleable through various educational interventions and changing environments (Manwaring et al., 2017); this potentiality makes learning engagement important to improving students' learning experiences and academic outcomes.

Against the backdrop of global informatization and the post-pandemic era, BT has gradually become one of the most widely recognized and efficient strategies used in instructional activities, which ensures that students can acquire knowledge and skills without time and space constraints (Bordoloi et al., 2021; Castro, 2019; Ghani & Taylor, 2021; Hamilton & Tee, 2013; Trujillo Maza et al., 2016). The BT format emerged as an innovative combination of traditional face-to-face classroom and online teaching activities, incorporating modern information and communication technologies (ICT) and rich online learning resources. The format holds paramount importance in driving innovation in vocational education, significantly influencing students' learning outcomes, and catering to diverse learning styles and preferences (Duman & Gencel, 2023; Megahed & Hassan, 2022; Wang & Wang, 2017). Simultaneously, the ongoing advancement of 5G, modern ICT and the Internet of Things have promoted their deeper integration with education, facilitating the continual development of the BT format (Alieksieiev et al., 2023; Dziuban et al., 2018; Otravenko et al., 2022).

However, BT is by no means a simple superposition of online and offline teaching activities – it aims to take advantage of modern ICT and resourceful open online materials to empower classroom teaching and give full play to the complementary advantages of the two (Lasekan et al., 2024), considering the various obstacles to the fully online format, like learners' disability in time management and self-regulation (Rasheed et al., 2020), sense of isolation (Kara et al., 2020), high reliance on teachers (Jokinen & Mikkonen, 2013), and inefficient course design and teaching methods (Greenhow et al., 2022). Besides, vocational students' actual learning engagement in

the BT context is found to be lower than their college student counterparts (Wang et al., 2018). Therefore, the online and offline teaching environment, hardware and software teaching resources, teacher-student interactions, teaching design and organization are all influencing factors that should be integrated to achieve the optimal effect of BT (Krismadinata et al., 2020).

Towards this end, numerous researchers have substantiated the theoretical foundation and implementation principles of BT in different instructional scenarios (Akyol et al., 2009; Bakker et al., 2015; Bliuc et al., 2012; Bond, 2020; Chudaeva et al., 2023; Hamilton & Tee, 2013). Bandura's social cognitive theory and self-efficacy theory highlight the importance of interaction between the external environment (teaching and learning communities) and individual factors (self-efficacy, motivation, self-regulation) in the human knowledge acquisition process (Bandura, 1999). Furthermore, Garrison et al. proposed the community of inquiry model (teaching, social and cognitive presence) which can effectively facilitate teaching design and predict students' learning experiences in online or blended teaching contexts (Garrison & Arbaugh, 2007). Researchers found that under the context of BT, students self-directing their learning and engaging in collaborative learning rather than reception learning accounts for a large proportion (Amiruddin et al., 2023). The learning effect mainly depends on the efforts students devote to their studies, that is, the actual learning engagement in the blended learning process. However, there are some undesirable phenomena, such as 'high registration and low completion', cyber-loafing (Zhang et al., 2022), lack of proactive participation, truancy, superficial learning (Zhu, 2015) and so on, which seriously affect the learning quality in BT. How to identify and maintain vocational students' learning engagement in the BT context is one of the biggest challenges confronted by vocational teachers and practitioners (Alvarez, 2020; Henrie et al., 2015; Sinatra et al., 2015).

In recent years, an increasing number of researchers have begun to recognize the value of learning engagement in the context of vocational education and expressed positive attitudes and high expectations towards it (Lu et al., 2022; Mustapa et al., 2015; Ricky & Rechell, 2015; Wang & Wang, 2017). However, in-depth and comprehensive research is still rare in this field (Krismadinata et al., 2020). Most focus on specific teaching practices or explore the influence of a single factor on blended learning engagement, but few studies have systematically analysed the influencing factors and corresponding improving strategies of vocational students' blended learning engagement as a whole (Henrie et al., 2015).

In addition, over the last decade, digital learning platforms and BT devices have become increasingly "smarter" due to their association with modern technologies, such as 5G, virtual reality (VR), artificial intelligence (AI) and augmented reality (AR). Therefore, in order to better take advantage of BT in the field of vocational

education to promote students' learning engagement, it is necessary to consider the characteristics of both the contemporary technical environment and vocational students' characteristics. Therefore, based on the community of inquiry framework and social cognitive theory, this systematic review elucidates the influencing factors that affect learning engagement and the corresponding improvement strategies for vocational students in the BT context.

2. Research questions

The above discussion shows that despite the crucial role of students' learning engagement, there is a dearth of comprehensive investigation into vocational students' learning engagement in the BT environment. The current study critically reviews relevant literature to advance the understanding of vocational students' learning engagement, elucidating its influencing mechanisms and corresponding improving strategies. This will also provide some practical reference to policymakers and practitioners in designing BT practice. Thus, the following research questions were formed:

RQ1. What are the characteristics of studies on vocational students' learning engagement in BT based on the year published, type of journal, country context and methodological characteristics?
RQ2. What types of BT strategies are used to improve learning engagement in the vocational education context?
RQ3. What are the influencing factors on vocational students' learning engagement in the BT environment?
RQ4. What are the improvement strategies that will help vocational students' learning engagement in the BT environment?

3. Methodology

To ensure accuracy and validity, the present study is qualitative and adopted a systematic review methodology, which rigorously synthesised existing studies on a specific topic, aiming to gather, evaluate, and summarize evidence in a systematic, transparent, and replicable way. This systematic review followed a strict methodological framework to reduce bias and provide more reliable conclusions. Specifically, the research process adhered to stringent inclusion and exclusion standards, which are in line with the PRISMA requirements. These have been extensively used by researchers to assess the reliability and viability of review conclusions (Page et al., 2021). The four consecutive procedures of identification, screening, eligibility, and inclusion were used to find articles suitable for this study, as shown in Figure 1.

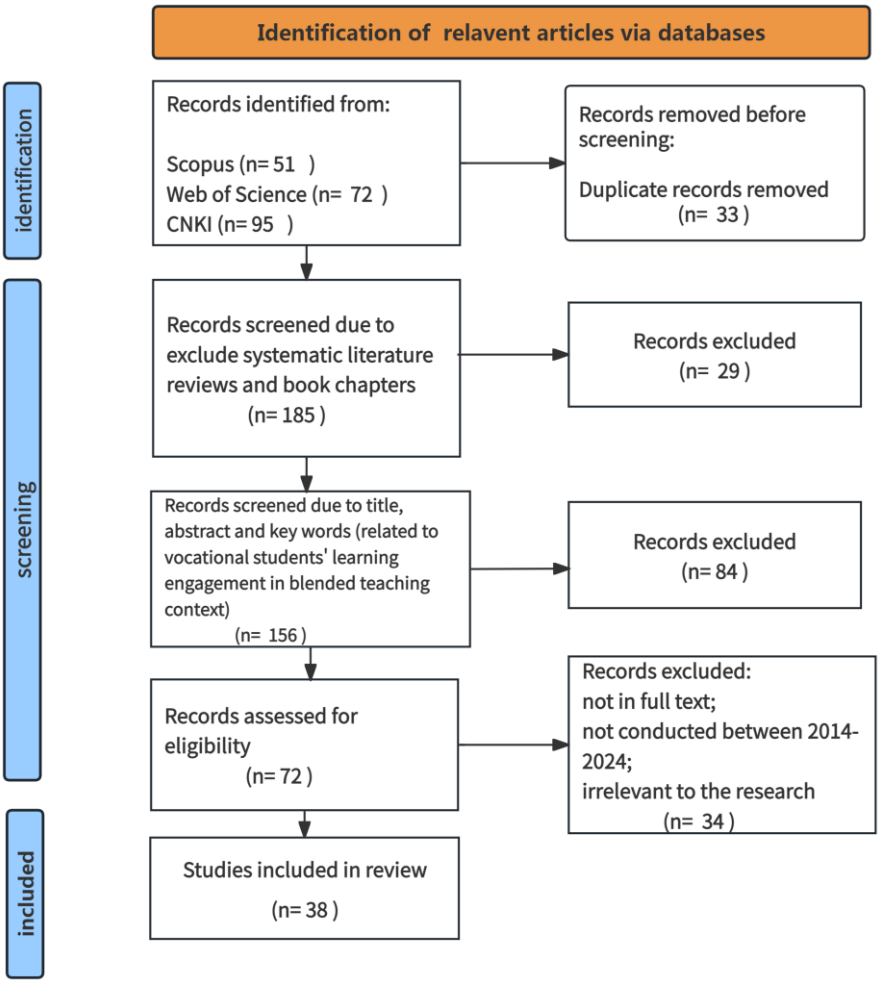

Figure 1. Flow chart for selection process of articles

3.1. Search strategy

Following the guidance of PRISMA, the first step of this systematic review was to identify the pertinent research on the subject from three major databases, namely Web of Science (WoS), Scopus and CNKI, which encompass a wealth of worldwide academic resources, including scholarly journals and theses. The key search strings were scientifically constructed and integrated to include as many relevant words as possible for the topic. Since BT is a relatively new term, hybrid teaching, blended education, blended learning, hybrid learning, and blended courses are used interchangeably and combined with vocational education. Table 1 lists the search strings adopted in this study to identify relevant articles from the three databases. It is worth mentioning that the time frame was set from 2014 to 2024 due to the significant development of online teaching platforms, the Internet of Things, AI, AR and other ICT-based teaching technologies over the past decade. This also marks a new chapter in the development of the BT mode in the vocational education field. In the end, 218 articles matching the search criteria were retrieved.

Table 1. Research string used for the systematic review process

Database	Search String
WoS	TS = (("blended teaching" OR "blended education" OR "blended courses" OR "blended learning" OR "hybrid teaching") AND ("learning engagement" OR "participation" OR "learning involvement") AND ("VET" OR "vocational education" OR "vocational college"))
Scopus	TS = (("blended teaching" OR "blended education" OR "blended courses" OR "blended learning" OR "hybrid teaching") AND ("learning engagement" OR "participation" OR "learning involvement") AND ("VET" OR "vocational education" OR "vocational college"))
CNKI	TS = (("blended teaching" OR "blended education" OR "blended courses" OR "blended learning" OR "hybrid teaching") AND ("learning engagement" OR "participation" OR "learning involvement") AND ("VET" OR "vocational education" OR "vocational college"))

3.2. Screening and inclusion

Following the identification of the 218 articles, the researchers found 33 duplicates using the reference management program EndNote. A total of 185 articles were produced as a result of further screening. Only journal papers (n=156) were considered; book chapters and systematic review articles were not. This choice was made as journal publications are usually longer than book chapters and subject to peer review, allowing for more in-depth information. They are therefore regarded as excellent research. To make sure the selected articles were pertinent to learning engagement, BT, and vocational education, these 156 articles underwent a second screening based on their titles, abstracts, and keywords. Eight-four items were eliminated during this procedure because they were thought to be unrelated to the goal of this review. Then, using the inclusion and exclusion criteria listed in Table 2, the remaining papers (n=72) were screened.

As a result, eight literature reviews were disregarded, and 26 articles were not accessible in full-text format from the database. To confirm the validity of this review, the quality of these 38 remaining papers was further evaluated following the inclusion procedure. Next, we looked through each article to check if the research questions were sufficiently covered. Several other factors were also assessed, such as the study design, sample size, sample selection techniques, data collecting protocols, data analysis methodology, and the degree of transparency and comprehensibility of the findings and conclusions. Each of the screened articles was judged appropriate for inclusion according to the evaluation findings. Detailed information (title, author and date) of the 38 articles is presented in Appendix A.

Table 1. Inclusion and exclusion criteria

Inclusion	Exclusion
Between 2014 to 2024	Earlier than 2014
Empirical study, dissertations, conference papers	Systematic review articles, book chapters, letters, etc.
Articles published in English	Articles not published in English
Related to influencing factors and improvement strategies of vocational students' learning engagement in a blended context	Not related to influencing factors and improvement strategies of vocational students' learning engagement in a blended context
In full text	Not in full text

4. Results and discussions

For this systematic review, a total of 38 articles regarding vocational students' learning engagement in the BT context from 2014 to 2024 were collected. These articles focused on the integration of BT and vocational education, using various technologies and instructional strategies to promote students' learning engagement from different perspectives. Based on this literature, we further addressed the research questions by describing the research sample and a detailed analysis.

4.1 The characteristics of research on vocational students' learning engagement in BT

4.1.1 Number of articles published by year

When we initially checked through the literature, we discovered that the publication number witnessed a slight rise in 2021 (n=6) and the following two years (as shown in Figure 2). An explanation for this phenomenon may be that the COVID-19 pandemic forced the global teaching practice to transition to online or the BT mode, thus BT was gaining unprecedented momentum and emerged as a hot topic. Coupled with the fact that modern ICT and the Internet of Things are becoming more advanced, BT will continue to play an important role in this post-pandemic era. Since it was only the first half of 2024, only four relevant articles had been published, and more were expected to emerge over the next few months.

Figure 2. Number of published articles from 2014 to 2024

4.1.2 Number of articles published by journal

The 38 journal articles included in this review were published in 34 different journals (see Figure 3); 17 (45%) in general education journals, 11 (29%) in vocational technology journals, 3 (8%) in discipline-specific journals (e.g. Distance Education, Engineering), 6 (16%) conference proceedings, and one dissertation. Among the journals where multiple articles had been published, the top three journals were Vocational & Technical Education, Computers & Education, and Education Research.

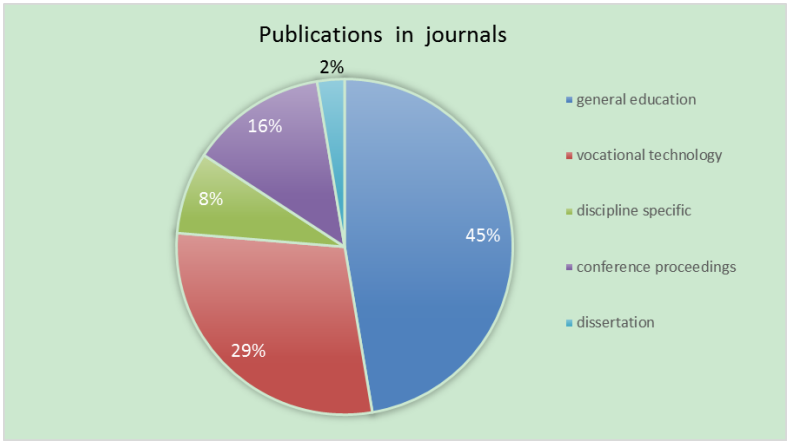

Figure 3. Number of published articles in different journals from 2014 to 2024

4.1.3 Country context

Concerning country context, Figure 4 demonstrates the distribution of articles based on country. It is evident that most studies in this review were conducted in China (40%, n=15), followed by Malaysia (13%, n=5), Indonesia (7.48%, n=4) and USA (7.48%, n=4). China seemed the most keen on investigating BT in the field of vocational education. This interest could be attributed to the fact that China has a population of more than 1.4 billion people, resulting in an educated population with a multi-level education system. The rapid development of science, technology and all walks of life in China over recent years has triggered a large demand for vocational

graduates. It has been urgent to reshape the education system through modern ICT to improve educational efficiency.

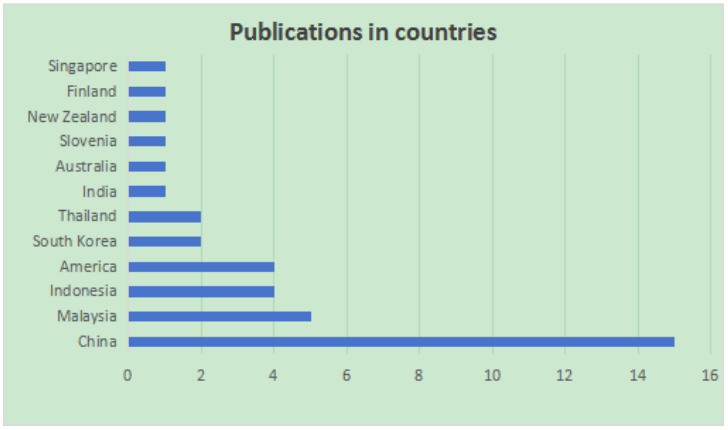

Figure 4. Number of published articles in different countries from 2014 to 2024

In addition, Malaysia, Indonesia, America and South Korea were the other countries that have shown significant interest in this research topic. When viewing the research contexts by continent, there was an overwhelming proportion in Asia (86.8%) and all belonged to developing countries, while very little research has been undertaken in other parts of the world. This may be because these developing countries have large educational populations and rapidly growing educational needs and ever-developing technologies.

4.1.4 Methodological characteristics

When reviewing the methodology employed in these articles, we found that 23 studies (61%) employed quantitative methods, five studies (13%) used qualitative methods and 10 studies (26%) used mixed methods. Obviously, quantitative analysis occupies most of such research, because statistical data and clarified measurement standards can more accurately support the conclusion and explain the problem. While the most frequently used method was experimental studies (29%, n=11), some research compared a traditional face-to-face classroom with BT methods, such as a study that implemented the virtual reality (VR) approach with a control and experimental group (Rafiq et al., 2022). Some other studies (Samah et al., 2022) measured and compared various kinds of learning effects (e.g. mean score, learning experience, satisfaction) between pre- and post-tests of students' learning engagement in the same group of students. All these studies came to a common conclusion that BT can effectively increase students' learning engagement, academic performance and overall outcomes.

Another commonly used research method used in these studies (18%, n=7) is the design and development research (DDR) approach with the adaptation of the ADDIE

model. What these studies have in common is that they all aimed to build a learning content prototype to assess the effectiveness of specific BT modes on student engagement in vocational teaching and learning such as gamification (Jayalath & Esichaikul, 2022; Samah & Ismail, 2021; Smiderle et al., 2020), Web 2.0 technologies (Mustapa et al., 2015) and the flipped classroom (Sarwa et al., 2021). As for the way to identify the different kinds and manifestations of learning engagement, given the preponderance of quantitative studies, it is then unsurprising that the most frequently used data collection tool was questionnaire surveys (61%, n=23), followed by ability tests and action statistics (42%, n=16) and interviews (21%, n=8).

4.2 Types of BT strategies used to improve learning engagement in vocational education context

The results of this review indicate that employing the correct teaching technology can provide strong support activities for both teacher and students, which will lead to enhanced learning engagement and satisfaction. However, as there is no single best teaching technology that fits all teaching environments and subjects, selecting a proper device is a critical step for success of BT. When reviewing literature pertaining to the design of BT, the researchers thoroughly examined 38 relevant articles, synthesizing insights on five predominant types of BT strategies as listed in Table 3. It is worth noting that 90% of the studies (n=34) employed no single pattern but comprehensively used a combination of two to three teaching methods.

Table 3. Types of technology used in BT mode

Technologies	Configurations	Study
Blended class with LMS (Google Classroom/Moodle /Treenity/Superstar)	Technology-rich instruction with support of online programs and learning management system (LMS), complement the in-person class.	[2][5][6][7][8][10] [11][13][14][15][17] [19][20][21][23][26] [32][33][37][38]
Rotation model /flipped classroom	After viewing a brief instructional video online, students join class to complete assignments like collaborative tasks.	[1] [6] [7] [10] [12] [15] [25] [26] [36]
Self-blend mode/ gamification	A program (game)-based modality. In addition to traditional in-person classes, learners also attend online programs.	[1] [2] [4] [18] [22]
Flexible-mode courses/ MOOC	Courses are available both online (MOOC) and in-person, learners are free to select how they want to complete it.	[9] [11] [20] [28] [29] [31]
ICT-based mode /social media	Delivering learning materials by means of enriched/augmented virtual (AR),	[3][5][6][7][8][10][12]

platforms	VR, computerized simulators, online video (YouTube) or social media platforms (We chat).	[14][16][17][19][20] [21][24][25][26][27] [30][33][34][38]

As demonstrated in Table 3, learning management systems (LMS) and ICT-based techniques are two applications that practitioners in BT for vocational education significantly favored. In the selected articles, 52.6% studies (n=20) employed a LMS as the primary tool, involving three predominant systems, namely, Google Classroom (Sarwa et al., 2021), Treenity (Huang & Liao, 2023) and Moodle (Jayalath & Esichaikul, 2022). This allowed students to access the learning materials before and after class using their laptop or mobile phone, thereby integrating online and offline learning efficiently. In addition, by means of automatic replies instead of the tutor's late written comments, an LMS may provide learners quick feedback (Domínguez et al., 2013), enabling students to adjust their learning behavior and further engagement in accordance with the formative assessment.

The frequency ranking was followed by the flipped classroom, MOOCs and gamification strategies. It is worth noting that the ICT applications, such as social communication software, online video platform, VR, AR, etc. are generally not used alone, but used as a supplementary mean in MOOCs, flipped classrooms and LMS. For example, in the MOOC learning program in Lan et al.'s study in 2019, YouTube video films were employed to further enrich the teaching content (Lan et al., 2018). Such social networking applications such as Ding Talk, Google Meeting and We Chat were usually integrated to facilitate interactions and collaborations in the learning process, especially in flipped classrooms and MOOCs (Sarwa et al., 2021; Xiong et al., 2015; Zhou & Han, 2018). Besides, apart from these common applications, in Rafiq's study, students experienced an immersive electrical engineering course in a classroom equipped with mobile VR devices (Rafiq et al., 2022). By taking part in a virtual scenario, students were able to immerse themselves in the learning process, block out distractions, and enhance their professional abilities. In the last two studies (Amiruddin et al., 2023; Gopinathan et al., 2022), the mobile platforms or applications used were not specified, and they did not stick to a particular platform. Rather, they made use of various applications, such as digital collaboration tools, to improve vocational students' involvement and engagement in BT lessons.

On the whole, studies in this review reported that these technological applications had a positive impact on students' participation and engagement, facilitating self-regulated and collaborative learning with increased learning autonomy.

4.3 Influencing factors of vocational students' learning engagement in the BT environment

This study found that the BT approach positively affected at least one dimension of student learning engagement in 94% (n=34) of the studies. However, the choice of BT strategy, implementation procedure and the overall performance were varied based on different teaching contexts and subjects. According to our review, as shown in Table 4, the influencing factors of students' learning engagement in the BT context can be categorized into three dimensions, namely, learning community, teaching presence and individual factors.

4.3.1 Learning community

Simply put, a learning community consists of a group of students who share ideas and collaborate with each other as well as the learning environment including diversified learning content, tools and platforms (Akyol & Garrison, 2008). Growing evidence shows that building a learning community does not only contribute to increasing students' participation and fostering actual learning engagement in both online and BT environments (Akyol et al., 2009; Arbaugh et al., 2008; Chudaeva et al., 2023; Garrison & Arbaugh, 2007; Jackson, 2020; Jia et al., 2023; Nasir & Ngah, 2022; Setiani & MacKinnon, 2015), but also helps to create a sense of belonging to a community and establish trust in peers as a resource of meaningful knowledge acquisition (Azhar & Amri, 2014; Shea, 2006).

As can be seen from this review, the most frequent (40%, n=15) indicators of learning engagement among these studies was the 'usefulness & accessibility of technology', which indicates that an appropriate choice of technology facilitates students' engagement by triggering their interest, providing more flexible and automatic learning format, yielding enhanced cognitive engagement and a better learning experience (Dinh, 2023; Kucher et al., 2023). For instance, the gamification method, mobile technology and virtual reality (VR) are all effective tools which can be used in BT (Rafiq et al., 2022; Ricky & Rechell, 2015; Samah et al., 2022).

Besides, eight articles (21%) mentioned that the quality and attractiveness of the learning material held paramount importance in promoting learning engagement (Kintu et al., 2017; Ricky & Rechell, 2015; Trigwell et al., 2013; Wang, 2022; Yates et al., 2020). This is because an obvious characteristic of contemporary vocational students is that they are more willing to access diversified information and learn by using various social communication software or information tools that they are familiar with and interested in, rather than rigid textbooks and assignments (Zhu, 2015).

Apart from the learning material and tools, it is worth noting a certain proportion of studies in this review did show that 'collaboration' (32%, n=15) and 'communication & interaction' (32%, n=15) effectively promote learning engagement in the BT

process (Wang et al., 2018; Zhong et al., 2022). These articles emphasized the importance of social relationships and collaborative learning in this learning community. It is enlightening that well-designed communication activities and platforms and collaborative learning tasks can effectively increase enjoyment, participation, and proactive learning engagement (Gopinathan et al., 2022; Hume et al., 2023; Ma et al., 2018; Mustapa et al., 2015). Interaction and collaboration are keys to building cognitive engagement because the interaction between peers or learning communities can reflect the learner's cognitive engagement such as critical thinking, reflective thinking and collaborative knowledge construction (Casimiro, 2016).

In this part of the review, the learning community factors that proved most predictive of students' learning engagement in BT programs included the following: well-designed learning communities with channels for students' communication, interaction and collaboration; high-quality learning materials both online and offline and appropriate teaching technologies and tools.

4.3.2 Teaching presence

According to the community of inquiry theory (Akyol & Garrison, 2008), teaching presence refers to the teachers' role and instructional activities to facilitate the meaningful learning experience of students, including teaching design and organization, interaction facilitation and direct instruction.

The results of this review confirmed that teachers' pedagogical activities played a crucial role in promoting student engagement through several influences (Caskurlu et al., 2020; Cho & Tobias, 2016; Dinh, 2023; Lan et al., 2018; Zhong et al., 2022; Su et al., 2023; Liao et al., 2023), such as 'teaching design & organization' (n=10, 26.3%), 'teachers' attitude and feedback' (n=9, 23.7%), 'direct instruction' (n=11, 29%) and 'discourse facilitation' (n=8, 21%). Especially in vocational education cases, a large proportion of practical courses require a high-quality instructor's facilitation in hands-on operation and workshops to support the acquisition of required competencies for future work and career development (Jayalath & Esichaikul, 2022), which can be supported by various ICT tools both inside and outside the classroom (Radovan & Radovan, 2024).

Given that BT emphasizes the subject position of learners, some research reminded course designers to bear in mind the characteristics of both the learners and the platforms to achieve greater cognitive and proactive behavioral engagement (Tay, 2016). Teachers played a crucial role in scaffolding students to successfully participate in self-paced learning activities and online discussions as well as gamification learning programs, providing clear guidelines and support on how to take part in these projects and thus facilitate their learning (Baker et al., 2017; Jung & Lee, 2018; Manwaring et al., 2017; Öncü & Bıchelmeyer, 2021; Tian & Song, 2024). For instance, using Forum/Google chat and face-to-face sessions in combination, paying

attention to both formative assessment and self-assessment can effectively intrigue students' active engagement (Nguyen et al., 2023; Radovan & Radovan, 2024).

In this part of the review, the factors that proved to contribute to students' learning engagement in BT programs the most included the following: well-designed teaching activities, assignments and organization; discourse facilitation and appropriate formative assessment and direct instructions and in-time feedback.

4.3.3 Individual factors

The findings from the reviewed studies indicated that a range of internal psycho-social influences can impact vocational students' learning engagement (see Table 4), including students' academic self-efficacy (18%), learning motivation (26.3%), self-regulation and self-assessment (8%), learning intention and career expectation (26%) and interest and curiosity (21%).

In recent years, scholars have paid increasing importance to individual factors due to the characteristics of BT in contemporary vocational education, that is, special emphasis on students' self-direct learning and cooperative learning (Huang & Wang, 2023; Wang et al., 2018; Zhong et al., 2022). To be specific, learning progress was effectively driven by individual factors such as self-regulation (Doo & Bonk, 2020; Kilis & Yıldırım, 2018; Sun & Rueda, 2012), learning motivation (Machumu et al., 2018; Tian & Song, 2024; Vanslambrouck et al., 2018; Xiong et al., 2015), satisfaction (Rafiq et al., 2023) and self-efficacy (Bonafini et al., 2017; Gong et al., 2018; Huang et al., 2019). Especially in the case of vocational education, students had a strong learning purpose, such as employment demand, expectation of future careers or obtaining a professional qualification. In order to enhance students' learning motivation, educators should place a high value on industry expectations and workspace simulation (Bonafini et al., 2017; Czaplinski & Fielding, 2020; Ricky & Rechell, 2015), especially in the MOOCs learning cases (Hume et al., 2023).

In addition, the reviewed studies also indicated that vocational students' interest and curiosity in course content and technical tools drove a strong motivation for proactive learning and persistence and that this could be achieved through diversified methods such as gamification, VR online video film, etc. On the whole, according to the self-determination theory (SDT) and social learning theory (SLT), these kinds of internal enablers can be influenced by the learning community and teaching presence elements mentioned above – these influencing factors can interact with each other and work together to boost students' learning engagement in different situations (Huang & Liao, 2023; Tian & Song, 2024).

To summarize, in this part of the review, the individual aspects that proved most prominent in terms of students' learning engagement in BT programs included the

following: motivation; self-efficacy; self-regulation; learning intention & career expectation; interest and curiosity.

In conclusion, the results of this review confirmed the effectiveness of BT for vocational teaching and learning by systematically integrating modern ICT and pedagogical practice. These researchers actively used various mobile tools, applications or platforms to extend offline classrooms to the BT environment. One point that should be noted is that there was no single absolute influencing factor that was most effective and applicable to all situations. That is, when considering the education interventions to enhance students' proactive attitude and engagement, the application scenario, student characteristics and hardware support should be considered comprehensively.

Table 4. Influencing factors, descriptions and dimensions of learning engagement

Indicators	Description	Dimension	Articles	Proportion
Teaching design & organization	Teachers' design of curriculum contents, providing learning materials, selection of teaching methods and tools, scheduling the learning process and pace, making adjustments in the teaching process	Teaching presence	[5][6][8][9] [10][13][24] [31][33][34] [35]	28.9%
Feedback /Attitude	Based on observation and evaluation of the learning process, teachers provide in-time and appropriate feedback to students		[8][9][10][13] [14][20][23][31][33]	23.7%
Direct instruction	Teachers' preparedness to share their knowledge of subjects, address particular problems with learners, clear up students' misconceptions		[5][6][8][9] [10][13][20] [23][24][31] [33]	29%
Discourse facilitation	Teachers' activity in assisting learners' acquisition of curriculum contents and critical thinking, facilitating them to participate in course activities, ensuring learners focus on learning tasks		[5][8][9][10] [13][20][31] [33]	21%
Motivation	Learners' learning motivation which directly pushes students to study	Individual	[1][2][4][10] [12][17][20] [21][22][23]	26.3%

Self-efficacy	Students' confidence in their own ability and behaviors to succeed in carrying out a learning assignment or task		[8][10][11] [13][20][31] [32]	18%
Self-regulation	Self-control and self-management behavior		[10][12][15]	8%
Learning intention &career expectation	Expectations for learning outcomes often take the form of career expectations or expectations for obtaining professional qualifications		[2][4][9][10] [24][27][28] [29][32][33]	26%
Interest & Curiosity	Students' interest and curiosity about specific projects or subjects are always a triggering event assigned by teachers		[2][3][4][10] [22][24][27] [38]	21%
Assessment (self-formative-)	Teachers' assessment and self-assessment of students' learning activities and performance	Teaching presence/ Individual	[10][14][37]	8%
Communication & Interaction	Open communication, emotional expression, and sharing ideas with peers	Learning community	[6][10][11] [14][17][25] [26][27][28] [33][35][38]	32%
Collaborative learning	Engage in teamwork, group tasks and construct group cohesion, work together to solve problems and assignments		[6][7][10][14] [15][16][17] [19][25][26] [33][36]	32%
Peers' observation	Students' observational learning by observing others' behaviors or experience		[7][10]	5%
Usefulness & accessibility of technology	The availability, ease of operation and usefulness of teaching tools		[1][9][10][14] [19][24][25] [26][28][30] [31][32][33] [35][38]	40%
Quality of learning material	Rationality, richness and attraction of course content		[7][10][17] [20][24][30] [33][35]	21%

4.4 Improvement strategies for vocational students' learning engagement in BT

Importantly, based on the influencing mechanisms on vocational students' learning engagement, this review further elucidates the corresponding improvement

strategies (see Figure 5), providing useful implications for policymakers and educators to better understand and promote vocational students' learning engagement when conducting BT practices in the future.

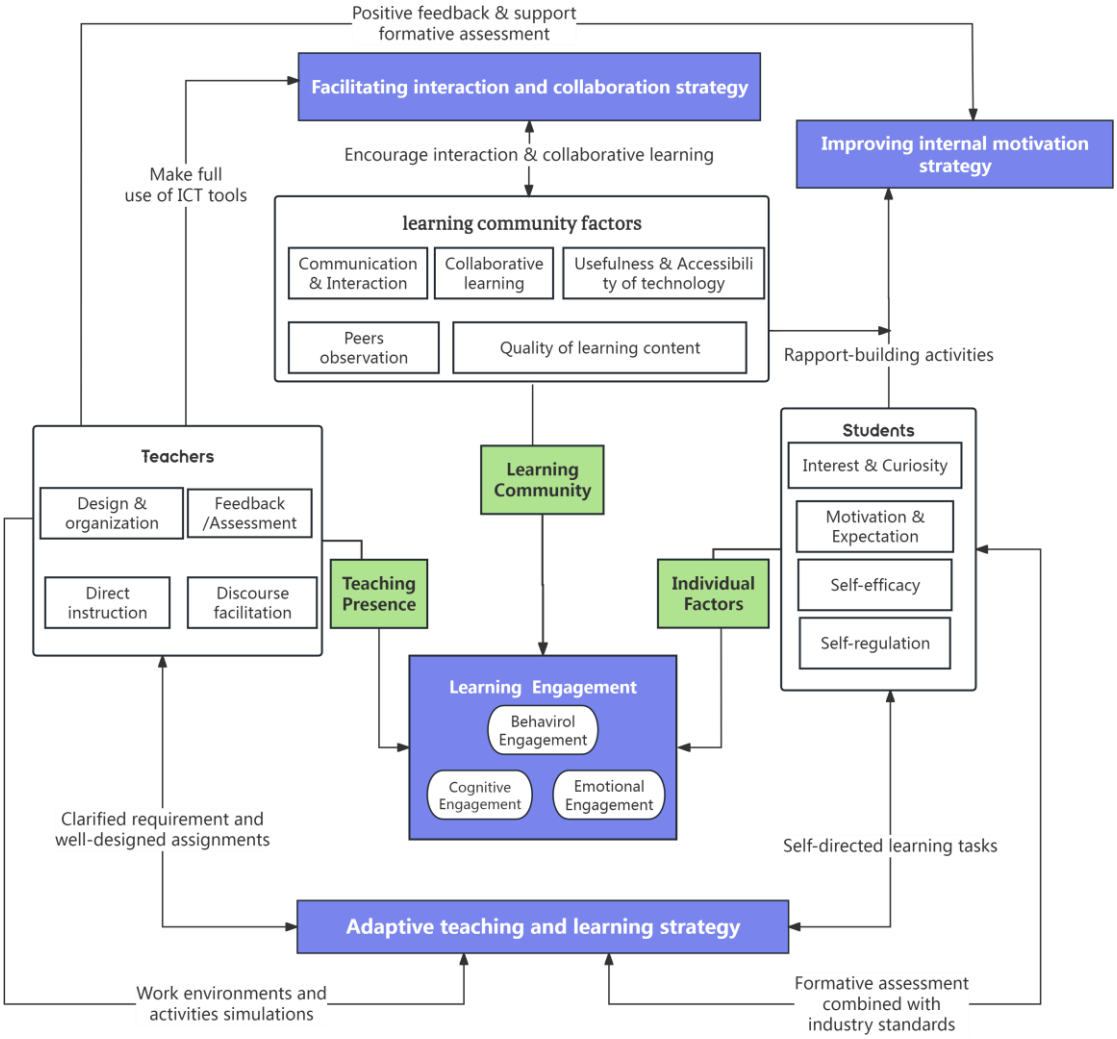

Figure 5. Influencing mechanisms and improvement strategies of vocational students' learning engagement in the BT context

4.4.1 Adaptive teaching and learning strategy

From the characteristics of BT and the overall influencing factors, this strategy starts from the combination of the 'teaching presence' and 'individual factors' perspective.

In this strategy, teachers should provide well-designed assignments (including both individual and group tasks) and clarify requirements. In addition, providing timely and personalized feedback along with support mechanisms such as digital mentoring or tutoring during the BT procedure is regarded as an important auxiliary teaching method in this strategy (Baker et al., 2017). Incorporating project-based learning, problem-solving tasks, and real-world applications can make learning more

interactive and engaging. Encouraging student participation in both the physical and digital aspects of blended learning environments is crucial (Bonk & Graham, 2005; Kintu et al., 2017; Lai, 2011). Besides, given students' preferences and learning styles, a certain level of flexibility and autonomy is also important. Offering flexible learning schedules and allowing students to choose between various types of learning activities can boost their engagement by catering to their own progress and rhythms.

The essence of "adaptive teaching and learning strategy" lies in its nature of adaptability and contingency – in this review, 'teaching design' has a significant influence on learning engagement where students show higher enthusiasm and engagement within learning communities where teachers can provide well-designed assignments, timely guidance and formative assessment (Hume et al., 2023; Nguyen et al., 2023). Thus, students can perform better in learning strategy adjustment (cognitive engagement), peer communication, information sharing and collaborative learning, and positive learning attitude (emotional engagement).

4.4.2 Improving internal motivation strategy

According to the synthesized influencing factors on learning engagement in Section 4.3, this strategy mainly focuses on the student's individual aspects. Studies in this review indicated the pivotal role of an individual's internal motivation and self-efficacy in predicting learning engagement; however, compared with ordinary college students, vocational students generally have a lower level of self-regulation ability and self-confidence, so they need more encouragement from teachers and peers (Huang, 2021; Machumu et al., 2018; Tian & Song, 2024; Vanslambrouck et al., 2018; Yuan, 2024).

In this strategy, students' internal motivation can be improved by the following measures. First, fostering a trusting and cohesive communication environment to enhance social presence and sense of belonging (Samah et al., 2022). For example, organizing online and offline rapport-building activities (Borrás-Gené et al., 2019; Smiderle et al., 2020), using gamified elements like badges, leaderboards, and interactive quizzes to help motivate students and tools like virtual simulations can enhance engagement. In addition, motivation can be improved by providing positive feedback and emotional support to strengthen academic self-efficacy (Wang & Wang, 2017); teachers can create a relaxed learning atmosphere, eliminate students' frustration (Radovan & Radovan, 2024), and enhance their emotional engagement.

Besides, it is worth noting that vocational students have a strong learning purpose, that is, for their future employment and career development – this strong intention was reflected in several studies from this review (Bonafini et al., 2017; Hume et al., 2023; Ricky & Rechell, 2015; Xiong et al., 2015). Accordingly, by simulating real work scenarios and taking the industry standards into account, teachers can help students

navigate possible difficulties and challenges in future work, boosting vocational students' learning intention and engagement.

4.4.3 Facilitating interaction and collaboration strategy

As can be seen from this review, by making full use of ICT-based tools, social media platforms and team tasks, teachers can stimulate students' interactive activities and cooperative learning behaviors, promoting their active course participation and behavior engagement (Wang & Wang, 2017).

As part of this strategy, gamification was an effective and commonly used approach in this review. Game badges, progress bars, challenging programs, and rewards were all effective tools to boost students' interaction and collaborative actions (Jayalath & Esichaikul, 2022; Samah et al., 2022; Samah & Ismail, 2021; Smiderle et al., 2020). Besides, encouraging group work through discussion boards, peer reviews, and synchronous video collaboration helped to foster social engagement and a sense of community. Social media and software have also expanded the channels and efficiency of online communication. Apart from interactions of teacher–student and student–student, guiding students to connect new learning materials with their previous knowledge and experience is conducive to meaningful learning construction, enhancing their cognitive engagement (Amiruddin et al., 2023).

In summary, by synthesizing various kinds of BT strategies and influencing factors on vocational students' learning engagement in the BT context, this study elucidated a comprehensive framework that involves the influencing mechanisms and corresponding improvement strategies that affect vocational students' learning engagement in the BT context. It provided implications for future BT design and implementation, especially on how to better understand and improve vocational students' learning engagement.

5. Conclusion and limitations

This study formulated specific, answerable research questions based on relative theories and conducted a thorough literature search from multiple databases under a detailed protocol that outlined the objectives, inclusion/exclusion criteria, search strategies, and methods for data extraction. By using the PRISMA framework, 38 articles published over the past decade on vocational students' learning engagement in the BT context were reviewed. In particular, this study focused on the multidimensional nature of students' learning engagement in the BT context – the predictors of learning engagement including both the environmental and individual factors – leading to a comprehensive framework of vocational students' learning engagement in the BT context that encompasses the influencing mechanisms and corresponding improvement strategies.

The study found that blended teaching and blended learning share similarities but diverge in focus, intent, and the range of elements; both require careful planning and execution. Blended learning focuses on the students' experience during the integration of online and face-to-face classrooms, while blended teaching delves deeper into pedagogical practices, assessment methods, and the overall educational environment. Understanding these distinctions can help educators create more effective and engaging learning experiences for their students.

The findings of this review indicated that the majority of research on BT reported at least one facilitator of students' learning engagement, such as increased learning satisfaction and motivation, active peers' interactions, and the employment of ICT tools such as LMS (e.g. Google Classroom and Treenity), social communication software (e.g. We Chat and Tencent Meeting), and various online learning materials (e.g. MOOCs and YouTube).

Notwithstanding this, an especially noteworthy finding is that the BT mode had a favorable effect on students' positive attitudes, motivation, curiosity, self-efficacy, and proactive engagement even if their exam results may not have increased considerably. In other words, apart from the academic outcomes, the emotional and social outcomes are also gratifying results. This overall outcome is also in line with the final goals of contemporary vocational education, in line with the standards of qualified professionals in this new era and conducive to cultivating the ability and habit of lifelong learning.

Moreover, based on the influencing mechanisms discovered in this study, corresponding strategies and practical references for vocational educators and policymakers are also proposed to improve vocational students' learning engagement level in BT from different perspectives. Combined with up-to-date theories on vocational students' learning engagement under blended teaching contexts, such as the Community of Inquiry model, Self-Determination Theory (SDT), Flipped Classroom Model and Self-efficacy Theory, it makes sense for teachers to fully take advantage of various ICT tools and online resources to stimulate students' interest in learning. In this way they can create opportunities and platforms for students to interact and communicate in the process of inquiry. At the same time, students' learning progress in real time needs to be measured and they should be given timely adjustment and feedback. Towards this end, policymakers and school leaders should attach enough importance to training teachers in information technology and blended teaching methods.

As for the limitations of this study, firstly, it is advisable to contemplate the influence of students' cognitive load. Admittedly, the rich information and technological environment based on BT will consume more cognitive resources of students which

are limited during the learning process; this consumption also places higher requirements on students' ability to retrieve and process information, so this excessive cognitive load will also affect students' learning engagement and actual performance. Moreover, social support, organizational culture, teachers' qualification level, family environment and other influencing factors in blended teaching environments should also be taken into account.

Given our limited literature sources and time frames, future studies could check even more databases, such as reviewing publications from a wider range of institutional or national theses repositories. Future studies could also investigate the potential effects of the comprehensive education system on students, including parents, teachers, friends, employers and the larger family–school–society community. Apart from the necessary professional knowledge and skills, this holistic education system could also impart vocational students some specific strategies for effective self-directed learning and digital competence and how to learn and collaborate with peers in a group setting. Towards this end, it calls for continued exploration of pathways to ensure students' learning engagement to navigate them through difficulties during the blended learning process and identify which strategies are more effective in practice.

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