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The relationship between teaching practices, dedication to learning, and the learning effect of blended learning from the perspective of adults

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Abstract

Nowadays, blended learning has emerged as a crucial teaching approach in response to the unique characteristics of adult learners and the integration of digital technologies in education. This study is to construct a theoretical model for understanding the impact of blended learning on adult learners, investigate the influence of teachers' attitudes and preparedness on student engagement, and examine the moderating effect of learning motivation. A questionnaire survey was conducted with 1532 expanded recruitment students. Data analysis was performed using a theoretical model that considered teachers' attitudes and preparedness as independent variables and students' cognitive, emotional, and behavioral engagement as dependent variables. The study investigated learning motivation as a moderating variable. This study found that teachers' attitudes and preparedness significantly promoted student engagement. The study discovered that learning motivation plays a moderating role in the connection between teaching attitudes, readiness, and student engagement. Student engagement acted as a mediator between teaching behavior and learning outcomes. The results have practical implications for improving teaching strategies and enhancing learning outcomes in adult. The findings provide valuable insights for vocational colleges in designing effective blended teaching strategies. They also guide educational institutions in improving teaching attitudes and preparedness, as well as motivating students to learn. Educators and policy makers can use these findings to optimize educational models and improve learning outcomes.

Keywords: Blended-learning, Efficiency, Enrollments, Expansion, Flexibility.

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1. Introduction

In both 2019 and 2020, the Chinese government implemented a consecutive enrollment expansion programme targeting students in higher vocational schools. This initiative successfully attracted a larger number of adult learners from diverse backgrounds to pursue further education in higher vocational colleges [1].The implementation of expansion measures can help the acquisition of advanced educational credentials by adult social groups, thereby enhancing the educational infrastructure of vocational colleges. The policy points out that adult student cohorts, such as eliminated soldiers and new forms of migrant workers, have the opportunity to acquire new skills through vocational education, thereby facilitating their attainment of high-quality employment [2]. The expansion of enrollment has resulted in an increase in the adult demographic among the student population, leading to more intricate social relationships and diverse societal roles being assumed by this group. These newly added student groups have significant differences in their learning abilities, learning methods, and educational backgrounds, and most of them are unable to engage in off-job learning [3]. Although the expansion of student enrollments in higher vocational education has attracted more adult student cohorts to study at schools, these social adult groups are different not only from their own social positions but also from their abilities to gain new knowledge and to study efficiently. Based on these giant differences, it is imperative for higher vocational education to take into account the distinctive characteristics of adult education. This entails incorporating the qualifications, career prospects, and teaching approaches of these students into an overall and perfect educational framework. By doing so, adult learners can be equipped with flexible training systems and various learning methods [4]. The adoption of a traditional planned learning approach may engender a state of internal conflict over the objectives of learning, hence giving rise to a range of practical challenges. These challenges encompass diminished interest in the learning process, reduced concentration on the information being taught, and substantial impediments to attaining optimal teaching efficacy [5].

Therefore, vocational colleges face challenges in effectively nurturing adult students who have been enrolled under the expanding policy, specifically in the context of off-job learning. By contrast, it is essential for these vocational colleges to priorities the balance between their studies and employment obligations, as well as the harmony between their studies and personal lives. This necessitates the establishment of a convenient learning environment in which they are better able to achieve the aforementioned balance through the implementation of flexible training systems and diverse pedagogical approaches. In light of the prevailing conditions surrounding the adoption of policies aimed at increasing student enrollments, the issue of how vocational colleges can effectively adjust to the resultant changes brought about by the influx of millions of adult college students has assumed significant importance. Consequently, the question of how these institutions can develop and implement an efficient teaching approach tailored to the needs of adult learners has become increasingly critical. To sum up, few teachers and institutions have explored the characteristics of adult education, so this essay aims to tackle the problem of how to educate adult students in an appropriate way so that the goal of attaining qualifications and fostering vocational competence can be accomplished. After the enrollment expansion policy, the Chinese government has also successively introduced some corresponding regulations to guide and ensure the smooth operation of promoting the adult group's qualifications at most colleges and universities. For example, *the Guidance on the Formulation and Implementation of the Program to Cultivate Professional Talents at Vocational Colleges* issued by the Ministry of Education of China pointed out that it is necessary for colleges to set up separate classes for the expanded group, specially revise the talent training program and give advice on the teaching approaches: teaching students by adopting flexible and diversified teaching methods, such as choosing school time freely, attending the mixed-class, and passing exams through credit bank. According to this situation, the implementation of Blended Learning Models, represented by the adaptable schooling system, has been embraced by higher vocational colleges to effectively integrate and differentiate the learning and employment of adult students. This approach enables this distinct group of students to seamlessly combine their educational pursuits with their individual circumstances, thereby catering to their personalized requirements in the pursuit of higher vocational education. [6]. Some studies have also confirmed the efficacy of Blended Learning, as a novel teaching mode that combines the advantages of traditional face-to-face education and online education. This amalgamation has been found to substantially enhance the teaching quality of educators and the learning efficiency of students. [7]. At this time, adopting Blended Learning Mode to meet the needs of different student groups and improve the learning outcomes of students has become an important development direction in vocational education.

Although higher vocational colleges have excellent teaching experience and research outcomes arising from relevant teaching models, which can guide the orderly development of teaching practices with Blended Learning. But there is still a lack of "practical" solutions to the tangible impact of learning on adult students. Exploring the practical matter of implementing "Blended Learning" in conjunction with the principles of "teaching in accordance with students' aptitudes" and "creating systems in accordance with students' capabilities" in order to effectively fulfill the students needs amidst expanding enrolments is a significant area of inquiry. Some existing studies have pointed out that teacher behavior in the Blended Learning Model has an important impact on learning engagement and learning outcomes [8-10], but most of the contemporary studies focus on those factors that only have an influence on learning engagement, while lacking in-depth research on the relationship between teaching and learning. In addition, there is still insufficient research on the impact of teaching practices on both learning engagement and academic achievements within the framework of Blended Learning contexts, especially in the realm of adult education [11, 12]. The effectiveness of Blended Learning is contingent not only upon the educational support provided by the online and offline learning environments but also necessitates alignment with the individual characteristics, autonomous behavior, and existing experience of students [13]. Moreover, the amount of research on learning motivation in Blended Learning among adult students is also limited.

According to the aforementioned limitations in existing research, this study focuses on investigating the influencing mechanism of the adult group learning effect within the context of Blended Learning environment The study utilizes a sample

of one million students who have been enrolled in higher vocational institutions through the expansion strategy. In this study, we want to examine the learning features of adult students who engage in extended learning opportunities and the specific requirements of the Blended Learning Model. Our objective is to develop an assessment system that effectively measures the learning outcomes of adult students within the Blended Learning context. Besides, we can also focus on students' psychological needs, learning motivation, the evaluation of their learning task, and their emotional experience in this system, thereby exploring the influence of different factors on learning effects. The findings of this study can encourage higher vocational colleges to find problems in the process of talent cultivation, such as how well the combination of online and face-to-face teaching arrangements can perform and how perfect management systems can reach Based on these findings, we can provide guidance and references for promoting the reform of Blended Learning modes, in which talents are cultivated among the adult group in higher vocational colleges.

2. Literature Review

2.1. Adult Education in the Expansion of Vocational Education

Different from conventional higher education, vocational education is a type of instruction that prioritizes career prospects and fosters students' practical occupational competencies and proficiencies. This form of education mainly focuses on nurturing technical and applied talents that are directly aligned with the demands of the job market. In contrast to the relatively homogeneous population of traditional students, vocational colleges are experiencing an influx of diverse adult learners, including retired soldiers, laid-off workers, and migrant workers. These individuals fulfil various social roles and constitute the key demographic for employment and entrepreneurial endeavors within the labor market. Students with a family background in certain sectors have put forward more specific requirements for the educational content and teaching objectives of vocational colleges, so the improvement in vocational abilities and social skills has become an urgent need for them [5]. Adult students who are enrolled in higher vocational education programmes through expansion policies generally hold specific positions in society, enabling them to accumulate extensive social and work experience. Consequently, it is imperative for higher vocational education to develop more appropriate teaching methods that cater to the unique needs of this special group of students while building upon the existing educational mechanisms at higher vocational colleges. The present study entails the broadening of the scope of higher vocational education to encompass the integration of continuing education and vocational training [14]. Integrating the learning motivation and personal characteristics of an expanded adult student group into vocational education is also a part of adult education, and it has an educational connotation.

The pursuit of adult education is a necessary means to attain a comprehensive lifelong learning strategy, encompassing continuing education, intellectual pursuits, and vocational training. However, some countries, such as the UK and France, that began the implementation of adult education in the early days did not have a clear definition of the concept of adult education. Some scholars have pointed out that adult education includes at least three aspects: the adult learning process, learning organization activities, and social and professional practices [15]. In the process of studying adult education, scholars have always been confused with some concepts like adult learning, vocational education, and continuing education, which reflects that theoretical research on adult education tends to fall behind the development process of educational practice. In fact, compared to children and adolescents, adults exhibit a higher level of physical and psychological development, hence assuming specific societal responsibilities and fulfilling significant tasks within their respective families [16]. On the basis of this, they tend to have stronger autonomy and self-awareness in learning things, with stronger learning motivation and clearer goals, so this important factor has become an educational practice for their abilities and knowledge to meet their own personal development [17]. However, due to the diversity of the role of the "adult" group, it is difficult to unify the diversity of their learning needs and the homogeneity of their learning content. According to the logic of motivation in adult group learning, some studies have pointed out that adult education encompasses more than just the pursuit of knowledge in adulthood. Rather, it entails a lifelong learning activity that individuals undertake following their departure from the conventional education system. This pursuit is aimed at fostering comprehensive personal development and adapting to societal development in accordance with their own needs and purposes [18].

In light of the principle of lifelong learning, adult education offers a very flexible timeframe for cultivating a group of adult learners, thus serving as a direct and efficient means of nurturing versatile abilities across several societal domains, unencumbered by temporal constraints. It has extremely strong practical guidance and a close connection with society. In the process of practical development, it continuously focuses on vocational skills training [19]. The practical logic for improving vocational skills is that adult education should be combined with vocational education to match the social demand for talents and the practical needs of people's own development. The primary significance of adult education is its contribution to social adaptability and personal growth. Adult education is a proactive educational approach designed specifically for adult populations, aimed at facilitating their adaptation to societal advancements and fostering their personal development. The life and work dynamics of adult groups are complex, and the transformation of adult roles will inevitably lead to various learning needs. Hence, it is imperative for adult education to prioritize the principle of students' self-development while also acknowledging their diverse learning styles and unique living circumstances. This approach aims to foster independent growth among adult learners, ultimately enabling them to fulfil their potential, contribute to society, and actualize their personal worth. Simultaneously, in the process of educating adults, we should pay attention to their educational achievement and the quality connotation of individual autonomous development, in addition to skill enhancement from multiple perspectives. Ultimately, the objective should be to facilitate the transformation of adults into fully developed individuals.

2.2. Blended Learning in Adult Education

Through examining the impact of e-learning on education and the return of classroom instruction, the blended learning method effectively overcomes the limitations of online learning while also reducing the cost of traditional teaching. This method plays an important role in addressing the diverse demands of adult education and solving the problems of adults who are unable to regularly attend traditional classroom settings due to work commitments or other obligations. By offering flexible options in terms of time and location, blended learning provides adult learners with a range of choices [20]. The advancement of mobile internet information technology has provided new technological tools for the implementation of mixed teaching in adult education, hence enhancing the platform for disseminating research findings in adult education. Moreover, the utilization of emerging intelligent technologies in blended learning, such as big data technology, enables the monitoring and analysis of students' learning behaviour based on students' data. This facilitates the identification of optimal research subjects and information sources for adult education research while also facilitating a comprehensive understanding of the underlying problems in adult education endeavors.

Blended learning is an instructional approach that effectively combines traditional face-to-face teaching with online teaching methods. This approach allows for the flexible allocation of teaching resources based on several factors, such as educational goals, individual student characteristics, and specific learning needs. By integrating both offline and online modalities, blended learning offers a dynamic and rational approach to education [7]. The primary emphasis of Blended learning lies not in the specific blend ratio of the two instructional methods but rather in the coordination between teachers' instruction and students' autonomous inquiry learning, both online and offline. This coordination aims to achieve a balance and determine the appropriate proportion of blending, as well as the selection of teaching resources and methods. Garrison proposed three teaching behaviors, namely teaching attitude, teaching preparation, and teaching mode, as core elements of the learning community theory [21]. The three dimensions of teachers' teaching attitude, teaching preparation, and teaching situation in the Blended learning model cover the strategies, structures, and supporting elements that are contained in the degree of preparation at the teacher level [13]. Teachers should support and implement the Blended learning model in their teaching attitude, with a particular focus on teachers' recognition of blended teaching and their proactive engagement in its application. In terms of teaching preparation, it mainly focuses on the preparation in advance for the effectiveness and rationality of the Blended learning teaching design, including the syllabus and specific implementation plan, course difficult assessment, and schedule [22]. The main focus in the educational context pertains to the specific implementation of both online and offline teaching approaches. This encompasses the particular methods employed for online learning in mixed conditions as well as the interactive teaching dynamics that occur between online and offline modalities.

The research on the implementation process and actual learning outcomes of Blended learning indicates that various factors, such as limited communication channels between students and teachers, delays in asynchronous learning, and reduced motivation to engage with online learning materials, can significantly impact the overall effectiveness of the Blended learning process [23]. Learning engagement is considered an important dimension of education quality assessment for students [24]. In the context of Blended learning research, it refers to the initiative and actual effort of students to participate in teaching activities. Jimerson's research suggests that learning engagement can be classified as a combination of cognitive, behavioral, and emotional components Jimerson, et al. [25]. Fredricks, et al. [26] also confirmed and proposed a theoretical framework for the cognitive, emotional, and behavioral dimensions of learning engagement [26]. The variable of learning input, as an individual characteristic of adult students engaged in Blended learning, holds significance as a study indicator for assessing the impact of Blended learning. The study conducted by Greenwood [27] clarified the direct impact of teachers' teaching practices on students' levels of involvement in the learning process, thus influencing their academic achievements. From a psychological research perspective, motivation should become the internal driving force for individual active learning and behavioral performance Zimmerman [28]. Niu [29] believes that motivation is the dominant factor that motivates certain behavior based on the individual's internal needs and external incentives acting separately or in both directions. Williams, et al. [30] pointed out that learning motivation is like a "catalyst", which can promote individual active learning by promoting attention, reinforcing learning attempts, and leading additional input. The autonomous learning behavior of students is inseparable from their motivation. Adult students who have greater flexibility in Blended learning, as a result of their unique learning needs pertaining to time, location, and pace, necessitate a stronger emphasis on active learning strategies. The aforementioned factor assumes a significant function in the facilitation, perpetuation, and reinforcement of learning behavior, hence serving as a catalyst for the advancement of adult educational endeavors [31].

In view of the diversity of blended learning, there are few studies on the impact of teaching behaviour on learning engagement and the learning effect. In addition, there is limited research in the field of adult education. This research focuses on the expanded enrollment of adult students and aims to explore the influence of teacher behaviour in blended learning on actual learning outcomes. It examines the learning input of adult groups in the context of higher vocational enrollment expansion. Additionally, it considers the influence of individual characteristics of adult groups (learning motivation, self-efficacy) on teaching behaviour and learning input. The study aims to provide more adaptive and effective improvement strategies.

3. Research Models and Assumptions

3.1. Research Model

Based on the above analysis, an impact model of adult-source Blended learning of "teaching behavior learning engagement, and learning effectiveness" is constructed. Students' internal learning engagement and external teachers' teaching behavior jointly affect the Blended learning. The teaching behaviour of external instructors has an impact on the

effectiveness of learning by influencing the internal engagement of students. Students' own learning motivation can promote the impact of teaching behavior on learning engagement. The model is shown in Figure 1.

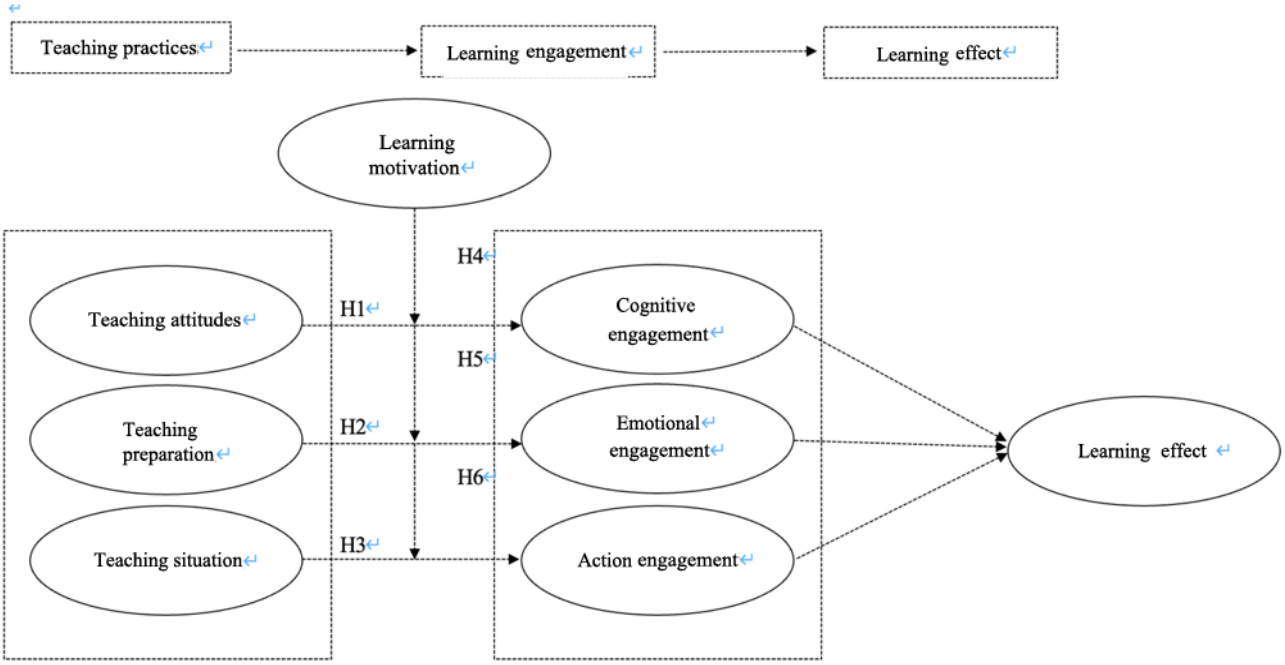

Figure 1.
Research model.

3.2. Research Assumptions

3.2.1. Research on the Impact of Teaching Behavior on Learning Engagement

Student engagement is known as a 'deepening agent of learning' [32], and increasing student engagement is an effective way to improve students' academic performance. It also reduces their boredom with learning and reduces dropout rates [26]. Existing research on the impact of teaching behavior on learning engagement has also confirmed that teaching attitudes, teaching skills, teaching content, teaching methods, and other teaching behaviors can affect students' proactive learning engagement in university classrooms [10]. In the study conducted by Liu, et al. [9], it was also found that teacher autonomy in teaching behavior significantly influences students' cognitive, emotional, and behavioral dimensions of learning engagement. pointed out that environmental factors and teaching practices can affect students' learning engagement. According to Shernoff [34], an investigation was conducted to examine the factors influencing learning engagement. The findings revealed that individual characteristics accounted for 25% of the observed variations in learning engagement, while the remaining 75% could be attributed to the learning environment. As a controllable element of teaching behavior, the learning environment can be designed by teachers to improve students' level of learning engagement through teaching contexts and teaching practices [35]. Teachers can also use students' preferences for the incorporation of technology in Blended learning to design a methodology that is more consistent with the principles of blended learning in order to promote students' levels of involvement in the learning process.

The majority of existing studies have demonstrated the positive influence of teaching behaviour on the enhancement of learning engagement within the context of Blended learning. However, limited research has been conducted to investigate the particular dimensions through which teaching behaviour affects learning engagement. Although Wang, et al. [36] pointed out that teaching preparation, teaching attitude, and teaching practice can affect students' learning effectiveness in Blended learning. The consideration of the method of learning input was inadequate. Blended learning offers the flexibility to adapt the format of classroom time and space in accordance with specific teaching circumstances. This allows teachers to strategically allocate time and content based on the educational objectives and the individual needs of students. [37]. Students can also use digital technology tools to preview or interact with difficult learning tasks before and during class. After class, they can also provide more feedback and communication to teachers and classmates through online learning expansion, promoting students' cognitive learning engagement in autonomous learning and self-management [38]. Through face-to-face and online communication and interaction, educators have the ability to provide increased emotional support to students in the context of group identity and Collaborative learning. This can result in heightened students' interest and enthusiasm for learning, as well as the facilitation of more profound emotional responses from students throughout the teaching process of Blended learning [39]. Moreover, the online digital learning resources of Blended learning can effectively support the dialectical unity of students' self-directed and classroom learning, overcoming the constraints of temporal and spatial limits inherent in conventional offline classroom education. The educational tools and content provided to students have effectively addressed their diverse and individualized needs. As a result, students are increasingly engaging in self-directed learning activities, such as pre-class preparation, active participation during class, and post-class reflection. Make the following assumptions:

Hypothesis$_1$: In the Blended learning model, teachers' teaching attitudes significantly and positively promote adult students' cognitive input (1a), emotional input (1b), and behavioral input (1c) in learning.

Hypothesis$_2$: In the Blended learning model, teachers' teaching preparation significantly and positively promotes adult students' cognitive input (2a), emotional input (2b), and behavioral input (2c) in learning.

Hypothesis$_3$: In the Blended learning model, teachers' teaching situations significantly and positively promote adult students' cognitive input (3a), emotional input (3b), and behavioral input (3c) in learning.

3.2.2. The Moderating Effect of Learning Motivation

The theory of learning motivation points out that subjective factors such as students' learning motivation and self-efficacy have a positive impact on their motivation to participate in the process of learning. Students with higher levels of motivation tend to exhibit greater awareness and control over their behavior. They consciously develop learning plans and goals, enabling them to effectively navigate challenges and ultimately achieve the intended goals [40]. Learning motivation is obviously an internal driving force that propels adult students to seek and be involved in Blended learning. Furthermore, understanding the genuine motive behind their learning endeavors is essential in guiding them to effectively acquire knowledge within the framework of a teaching organization. To achieve the established learning goals in the context of Blended learning, adult students must actively employ appropriate learning strategies during instructional activities to adjust their learning plans to their current circumstances. As the premise and basis for promoting their self-regulation process in the process of Blended learning, learning motivation plays a significant role in the self-regulation process of Blending learning, influencing the selection of learning content, task completion, and the pursuit and adherence to ideas and activities. Zimmerman, et al. [41]. Bandura [42] social cognitive theory suggests that a higher level of learning engagement is closely related to learning motivation. The degree of learning engagement can be increased only through the possession or maintenance of a robust level of anticipated learning motivation. Numerous studies have shown that the level of students' learning motivation plays a significant role in regulating their learning strategies during the learning process. Specifically, when students possess high levels of learning motivation, teachers' teaching behavior is more likely to facilitate their sustained involvement in learning activities [43]. The study by Schwinger and Stiensmeier-Pelster [44] also validated the positive relationship between learning motivation, task effort, and learning engagement. Fritea and Fritea [45] pointed out that the lack of learning motivation can easily lead to students experiencing learning burnout, diminishing their enthusiasm for acquiring knowledge and consequently diminishing their level of involvement in the learning process. The above analysis shows that the learning motivation of middle school students in the context of blended learning has a positive correlation with their engagement in teaching activities. But there is a lack of examination regarding the relationship between learning motivation and specific dimensions of teaching behaviour and learning input. This study presents hypotheses based on the influence of learning motivation on the behavioural organization and learning engagement of teachers' teaching activities.

Hypothesis$_4$: The learning motivation of adult students regulates the influence of teachers' teaching attitude on learning cognitive input (4a), emotional input (4b), and behavioral input (4c) in the Blended learning model; that is, the stronger their learning motivation, the greater the influence of teachers' teaching attitude on their cognitive input, emotional input, and behavioral input.

Hypothesis$_5$: The learning motivation of adult students regulates the influence of teachers' teaching preparation on learning cognitive input (5a), emotional input (5b), and behavioral input (5c) in the Blended learning model; that is, the stronger their learning motivation, the greater the influence of teachers' teaching preparation on their cognitive input, emotional input, and behavioral input.

Hypothesis$_6$: The learning motivation of adult students regulates the influence of teachers' teaching situation on learning cognitive input (6a), emotional input (6b), and behavioral input (6c) in the Blended learning model; that is, the stronger their learning motivation, the greater the influence of teachers' teaching situation on their cognitive input, emotional input, and behavioral input.

3.2.3. The Mediating Role of Learning Engagement

When students are engaged in the learning process, they demonstrate positive learning states such as cognitive performance, emotional stability, learning effort, and focus. This is known as learning engagement. All things considered, it is a physical representation of students' absorption into the learning process. Learner engagement has been shown to be strongly correlated with learning outcomes in a number of studies, indicating that it is an important factor in determining students' academic success. The majority of research has established learner engagement as a key factor influencing students' academic achievement by confirming the high association between it and learning outcomes. Fredricks, et al. [26], Liem, et al. [46] and Wu and Zhang [47]. Ronimus, et al. [48] also pointed out that learning engagement is an effective indicator of satisfaction and learning effectiveness in online learning. Students with high levels of learning engagement can fully engage in the process of learning, successfully complete established learning plans, and achieve satisfactory learning outcomes. In contrast to students who engage in full-time academic pursuits, individuals who study while also maintaining adult responsibilities and work status are more likely to encounter circumstances that hinder their ability to concentrate on their learning, maintain a stable learning state, and adhere to a consistent learning process. Consequently, these individuals may face challenges in fully immersing themselves in the act of learning [49]. However, from existing research, it can be seen that in learning states where learning engagement is difficult to concentrate, the improvement of students' learning engagement is more likely to affect their actual learning outcomes [50, 51].

Greenwood [27] confirmed the direct impact of teaching behaviour on learning engagement and the indirect impact on students' academic performance within the framework of an established teaching paradigm. Some studies also point out that

the effective application of teachers' teaching strategies in blended learning is the key factor that affects students' level of involvement. It is necessary to promote an atmosphere of active learning through the actual preparation of online resources and the construction of teaching and learning situations. In the context of blended learning, students have the opportunity to receive timely feedback and evaluation from their teachers, which can contribute to enhancing the efficacy of their learning experience. McGee and Reis [52]. Korr, et al. [53] also emphasized the importance of adequately preparing and implementing instructional resources to effectively address students' learning content requirements, hence fostering an active learning goal of pursuing knowledge. The research of Boelens, et al. [54] further supports the positive impact of teachers' using the advantages of blended learning to establish a learning atmosphere of emotional support on learning engagement and learning effectiveness. According to the situational learning theory, in adult education, it is necessary to ensure that adult students are in a relaxed and joyful learning atmosphere of mutual respect, immerse themselves in practical situations closely connected to real life, and pay attention to the realization of social interaction in order to increase the participation and investment of adult students in educational pursuits and attain the most favorable outcomes in terms of learning efficacy. From this perspective, the accurate and appropriate application of teachers' teaching behaviour in blended learning can enable adult students to form their own learning rules, methods, and skills, eliminate their tension and anxiety caused by uncertainty factors in the learning process, and actively use new tools and new technologies to complete learning tasks, ultimately achieving the goal that adult students can consciously learn to improve the learning effect. Based on the above analysis, the following assumptions are made:

Hypothesis$_{7}$: In Blended learning, teachers' teaching attitudes significantly affect students' learning outcomes through their cognitive involvement (7a), emotional involvement (7b), and behavioral involvement (7c).

Hypothesis$_{8}$: In Blended learning, teachers' teaching preparation significantly affects students' learning effects through their cognitive involvement (8a), emotional involvement (8b), and behavioral involvement (8c).

Hypothesis$_{9}$: In Blended learning, teachers' teaching situations significantly affect students' learning effects through their cognitive involvement (9a), emotional involvement (9b), and behavioral involvement (9c).

4. Research Methods

4.1. Research Procedure

Although vocational colleges across China have carried out enrollment and teaching programmes to expand the enrollment of adult students, the randomness of such groups makes it difficult to conduct research, and there is a lack of effective ways to accurately distinguish them. Therefore, in the actual sample selection process, vocational colleges familiar to this researcher were used as the main sample group for the questionnaire survey. This study aims to investigate the variability in college types and majors by selecting a comprehensive sample of extended enrollment from three distinct vocational institutions specializing in finance, engineering, and science, denoted as A, B, and C, respectively. The cohort of students who were admitted to the institution in 2019 and experienced an increase in enrolment are currently on track to graduate in 2022, having already completed their respective courses. They are currently undergoing the internship process. Therefore, the present research cohort comprises students enrolled in the enlarged programmes of A, B, and C universities throughout the years 2020 and 2021. The two universities, B and C, have experienced an increase in enrolment of around 300 students across all academic levels, with an average of 50 students per class. Every tier provides a cumulative sum of six courses. The official scale for this study was distributed in June 2022. To avoid the fatigue caused by the excessive number of items in the questionnaire and to ensure the coherence of the question content, this study employed the strategy of dividing the questionnaire into three sections and administering them in three separate installments. This approach aimed to minimise any interference with the participants' test intentions. Among them, the first measurement includes individual basic information, learning motivation, teaching attitude, teaching preparation, teaching situation, and other information that emphasizes teacher teaching behavior. The second measurement includes information that focuses on students' learning engagement, such as cognitive engagement, emotional engagement, and behavioural engagement. The third measurement is mainly for the measurement of blended learning effects. As the learning process approaches the end of the semester, the teaching behaviour of instructors in blended learning includes comprehensive information pertaining to the teaching process during the first measurement period. Subsequent measurements, on the other hand, provide insights into students' perceptions and actual learning outcomes, thereby better reflecting their own understanding and progress. Therefore, the approach and content of the three distributions are deemed feasible in terms of both process and meaningful expression. The measurement process is facilitated by the instructor and shared with the class through a questionnaire issued during in-person classroom instruction. It is emphasized that completing the questionnaire is regarded as an activity that promotes learning within the classroom setting. Finally, the combined questionnaire is ultimately summarized according to the mobile phone tail number items to generate comprehensive measurement data for the adult source. Blended learning effect and impact model.

4.2. Variable Measurement

. The present study refers to the items on the scale that have been demonstrated to be effective or well-established in the existing literature both domestically and internationally. These items are utilized as a point of reference, and the measuring items that serve as variables in this study are adapted in accordance with the specific circumstances of this research. The Likert scale is utilized for scoring, employing a 5-point system, while the questions are structured as single-choice queries. To ascertain the characteristics of teaching behavior, it is recommended to consult the teaching behavior research scale developed by Jing [55] and Wang, et al. [36]. These scales can be adapted to the context of adult blended learning to ensure appropriate modifications are made. Among them, teaching attitudes include three items: teachers' highly positive attitude during the teaching process, teachers' strong sense of responsibility during the process of imparting knowledge, and teachers'

active practices of online education; Teaching preparation includes four items: “sufficient preparation of materials for teaching; sufficient online resources from which the teacher can draw upon; the use of diverse teaching practices during the teaching process; and assessment from multiple directions. “The teaching situation includes four items: strengthened communication between teachers and students as well as students themselves during the teaching process; prompt feedback from teachers on students’ perplexity; the guidance of teachers to students in discussions in the class; and the instruction and assistance of the teaching assistant during a class. The learning engagement scale mainly refers to the learning engagement scale of Wang [56] and Xu [57], where cognitive engagement includes 5 items: ‘I often mark the key and difficult content in the learning materials during a class’, ‘I tend to do some previews about the relevant contents’, ‘I am bound to do some reviews after a class’, ‘I tend to find some connections between what I have learned and what I am about to absorb’, ‘I will seek some extra-curricular knowledge to help me understand some key notions’; Emotional engagement includes 5 items: ‘I am always curious about the content of the course I am going to learn’, ‘I always expect the course that is about to be taken’, ‘I always feel happy and satisfied when I am taking a course’, ‘I feel delighted when I am having a discussion with my classmates’, and ‘I can feel the respect from my teachers and classmates for my opinions’; Behavioral engagement includes 5 items: ‘I will regularly study the relevant materials provided by the course according to the course requirements’, ‘I will try my best to participate in every activity involving the course’, ‘I will not undertake those unrelated to the course during a class’, ‘I will actively share my views and resources with my teachers and classmates’, and ‘I will also actively respond to the questions, inquires, or online discussion during the process of taking a course’ . Learning motivation is adapted from the Learning Motivation Scale by Wang, et al. [38] & Wu and Wang [58], which includes 8 items: ‘I mainly take a course to increase my interest in knowledge acquisition ’, ‘I take a course to widen my horizons’, ‘I take a course to challenge and then improve myself’ , ‘I take a course to find answers and solutions to the constant questions and problems arising from studies and daily life’, ‘I take a course to obtain a qualification’ , ‘I take a course to ease my pressure from work or finding work ’, ‘I take a course due to the influence exerted by my family as well as the society as a whole’ and ‘I take a course to build up a network of contacts'.

This study examines the learning effectiveness of adult students to comprehensively assess their academic performance, learning satisfaction, and self-evaluation. In order to ascertain the relative significance of the three dimensions of the learning effect within the adult group, a study was conducted involving consultation with three experts in the field of educational technology. The findings of this study revealed that learning achievement accounted for 20% of the overall learning effect, while learning satisfaction and self-evaluation learning effects each contributed 40% to the overall learning effect. The final comprehensive score obtained through the final evaluation of adult-source courses is self-evaluated by students. The course score is scored on a 5-point scale based on the criteria of "excellent (90 points or above), good (80–89 points), medium (70–79 points), qualified (60–69 points), and poor (below 60 points)". Learning satisfaction, self-evaluation, and learning effectiveness are obtained through the questionnaire of self-evaluation. Learning satisfaction is adapted from the Blended learning satisfaction scale of Cheng and Chau [59], which includes 10 items: ‘I am relatively satisfied with the curriculum content’, ‘I am satisfied with the teaching practice of the course’, ‘I am satisfied with the design of some activities involving the course’, ‘I am satisfied with the difficulties of tests in the course’, ‘I am satisfied with the assessment criteria of the course’, ‘I am satisfied with the teaching quality of the course’, ‘I am satisfied with the interaction and feedback during a course’, ‘I am satisfied with the functions of the online course platform’ and ‘My satisfaction is relatively high about the overall teaching quality when taking into all those factors mentioned above’. The self-assessment of learning effectiveness is adapted from Jiang, et al. [60] evaluation of the learning effectiveness of MOOCs (Massive Open Online Courses) students, which includes 7 questions: ‘Through learning, my autonomous learning ability has been improved’, ‘Through learning, my analytical ability and problem-solving ability has been improved’, ‘Through learning, my capabilities of absorbing and handling information have been improved’, ‘Through learning, my collaboration and communication skills in teamwork have been improved’, ‘Through learning, my ability to put theory into practice has been improved’, ‘Through learning, my ability to raise questions and express my views clearly has been improved’ and ‘Through learning, my time management ability has been improved..

5. Hypothesis Testing and Results

5.1. Sample

Finally, a total of 1532 valid questionnaires were obtained. The specific population characteristics of the sample are shown in Table 1. The data shows that the gender proportion of the final sample survey is relatively balanced, with women accounting for 47.06% and men accounting for 52.94%. The increase in enrollment primarily stems from the adult demographic, while a relatively small percentage of students under the age of 20, specifically 4.70% contribute to this expansion. Notably, individuals between the ages of 30 and 39 make up a significant proportion, accounting for 50.78% of the total enrollment. Furthermore, the population aged 50 and above also represents a noteworthy segment, comprising 2.94% of the overall enrollment. This data suggests that there is a considerable demand for learning within this age group. In terms of occupational groups, the proportion of laid-off workers is notably the highest, reaching 80.09%. This observation also indicates the pressing necessity for vocational training and reemployment education to support the development of vocational sectors. The prompt emphasizes the pressing need for laid-off workers to improve their academic qualifications and receive practical skills through vocational expansion programmes. This is crucial in order to effectively address the demands of reemployment and job selection. In terms of income level, the majority of the income groups are below 2000-yuan, accounting for 66.91%, followed by the income stage of 2000-2999. The consecutive drop in the number of high-income samples aligns with the fundamental relationship between money and education. The assessed adult student population is experiencing a decline that aligns with their years in the workforce. This trend is in line with the observation that individuals with more

extensive job experience are less inclined to continue vocational education. Overall, the samples in this survey have good representativeness.

Table 1.
Sample demographic characteristics.

Sample characteristics	Project content	Number of samples	Percentage
Gender	Male	811	52.94%
	Female	721	47.06%
Age	Under 20	72	4.70%
	20-29	425	27.74%
	30-39	778	50.78%
	40-49	212	13.84%
	50 and above	45	2.94%
Occupation category	High school and vocational school graduates	49	3.20%
	Migrant workers	77	5.03%
	Laid-off workers	1227	80.09%
	Veterans	69	4.50%
	A new type of skilled farmers	101	6.59%
	Others	9	0.59%
Income	Below 2000 Yuan	1025	66.91%
	2000-2999 Yuan	256	16.71%
	3000-3999 Yuan	133	8.68%
	4000-4999 Yuan	99	6.46%
	Over 5000 Yuan	19	1.24%
Years of service	Less than 1 year	652	42.56%
	1-3 years	466	30.42%
	3-5 years	221	14.43%
	5-7 years	103	6.72%
	Over 7 years	90	5.87%

Table 2.
Differentiation validity test results.

Variable	Mean	SD	Cronbach's α	1	2	3	4	5	6	7	8	9
1.Teaching attitude	3.512	0.538	0.889	0.760								
2.Teaching preparation	3.207	0.721	0.903	0.481	0.752							
3.Teaching situation	3.304	0.712	0.896	0.476	0.394	0.782						
4.Cognitive engagement	3.512	0.618	0.820	0.489	0.407	0.415	0.799					
5.Emotional engagement	3.765	0.562	0.919	0.343	0.354	0.353	0.395	0.809				
6.Action engagement	3.762	0.457	0.920	0.349	0.365	0.366	0.413	0.448	0.760			
7.Learning motivation	3.460	0.351	0.857	0.343	0.418	0.421	0.330	0.330	0.420	0.808		
8.Learning effect	3.694	0.322	0.924	0.367	0.396	0.411	0.414	0.426**	0.509**	0.478	0.612	0.832

Note: * * p<0.01; The bold numbers on the diagonal represent the square root of the variable AVE, while the data below the diagonal represents the correlation coefficients between the variables.

5.2. Reliability and Validity

According to the findings presented in Table 2, the Cronbach's partial consistency coefficient (α) for each variable was examined. The minimum value of this coefficient was found to be 0.820, which surpasses the reliability requirement of 0.7 or above. This suggests that the scale employed in this study achieves the required level of reliability. The bold numbers on the diagonal of Table 2 represent the square roots of the average extraction variance (AVE) of each variable. The analysis reveals that all variables exhibit AVE values over 0.7, and the square roots of AVE surpass the correlation coefficients between these variables and other variables [61]. This finding suggests that the study model has favorable levels of aggregation and discriminant validity. This study conducted confirmatory factor analysis using AMOS (Analysis of Moment Structure) 22.0 data analysis software. The analysis results for model fit and validity are shown in Table 3. The results in Table 3 show that all indicators are within the reference range, hence providing additional support for the structural validity of the model.

Table 3.
Analysis of simulated fitting indicators.

Model fitting indicators	Reference range	Model indicator values
Chi square degree of freedom ratio (χ2/df)	<3	1.923
Approximate error root mean square (AERMS)	<0.05	0.033
Goodness of fit index (GFI)	>0.80	0.876
Allocation system (AS)	>0.80	0.912
Normalized fit index (NFI)	>0.80	0.905
Comparison fit index (CFI)	>0.80	0.922
Root mean square residual (RMSR)	<0.05	0.039
90%CI	Not zero	[0.038,0.047]

5.3. Data Verification Results

5.3.1. Direct Action Relationship Test

In order to ascertain the specific impact of construction in the research model, this study employed regression analysis utilizing SPSS (Statistical Package for the Social Sciences) 25.0 statistical analysis software. The dependent variables in this analysis were the dimensions of learning investment and learning effectiveness. Table 4 presents the findings of the direct effect test, which examines the impact of teacher teaching behavior on the learning engagement of a varied student population. The data results show that in the dimension of cognitive engagement, teaching attitude, teaching preparation, and teaching context all have a positive promoting effect on it (B=0.219, p<0.01; B=0.365, p<0.01; B=0.238, p<0.01), thus supporting hypotheses 1a, 2a, and 3a. In the realm of emotional input, the teaching attitude and teaching preparation of instructors in Blended learning exert a noteworthy positive impact on the emotional input of a diverse student population (B=0.332, p<0.01; B=0.230, p<0.01). Hypothesis 1b passed the test. In contrast to the cognitive component, the influence of instructional context on emotional engagement did not yield statistically significant results (B=-0.017, p=0.38), hence failing to support hypothesis 3b. In the dimension of behavioral engagement, teachers' teaching attitude and preparation also showed a positive impact on the behavioral engagement of students (B=0.362, p<0.01; B=0.269, p<0.01). As a result, hypotheses 1c and 2c were confirmed. However, consistent with the dimension of emotional engagement, the impact of teaching context on behavioral engagement is not significant (B=-0.089, p=0.135), and hypothesis 3c is not valid.

Table 4.
Regression results of direct-action relationship.

Variable	Cognitive engagement	Emotional engagement	Action engagement	Learning effect
	M1	M2	M3	M4
Gender	-0.282** (0.030)	-0.322**(0.033)	-0.319**(0.034)	-0.064**(0.014)
Age	0.209** (0.021)	0.285**(0.023)	0.263** (0.023)	-0.005(0.009)
Occupation category	-0.018**(0.006)	-0.021**(0.007)	-0.024**(0.007)	0.011**(0.003)
Income	-0.022*(0.010)	0.017 (0.011)	-0.003(0.011)	-0.001(0.005)
Years of service	-0.076**(0.013)	-0.144** (0.014)	-0.126**(0.014)	0.015* (0.006)
Teaching attitude	0.219**(0.037)	0.332** (0.032)	0.362**(0.032)	
Teaching preparation	0.365**(0.065)	0.230** (0.029)	0.269** (0.033)	
Teaching situation	0.238**(0.053)	-0.017(0.059)	-0.089(0.059)	
Cognitive engagement				0.219** (0.023)
Emotional engagement				0.352** (0.027)
Action engagement				0.212** (0.029)
Constant term	2.606**(0.089)	3.124**(0.098)	3.077**(0.099)	0.588**(0.056)
R^2	0.480	0.491	0.511	0.577
Adjusting R2	0.477	0.488	0.509	0.572
F	175.633**	183.510**	199.008**	1351.530

Note: N=1532, * p<0.05, * * p<0.01; The non standardized regression coefficients are shown in the table, and the standard errors are shown in parentheses.

The results in Table 4 also show that the cognitive input, emotional input, and behavioral input of adult students in Blended learning can positively and significantly affect their own learning (B=0.219, p<0.01; B=0.352, p<0.01; B=0.212, p<0.01). This first finding suggests that there exists an indirect relationship between teaching behaviour and learning effectiveness mediated by learning engagement.

5.3.2. Hypothesis Test of Regulatory Relationships

The hypothesized moderating link was examined using the hierarchical regression analysis method with the aid of SPSS (Statistical Package for the Social Sciences) 25.0 statistical analysis software. The data presented in Table 5 shows that the inclusion of interaction terms such as learning motivation, teaching attitude, teaching preparation, and teaching situation in the regression equation M2, with cognitive engagement as the dependent variable, resulted in an increase in the R2 value from 0.451 in M1 to 0.469. This increase indicates that the model's ability to explain the variance in the dependent variable was improved with the addition of these variables. The data results also show that the interaction between learning motivation and teaching attitude has a positive and significant impact on cognitive engagement (B=0.223, p<0.01), and the interaction between learning motivation and teaching preparation has a positive and significant impact on cognitive engagement (B=0.211, p<0.01). This finding suggests that within a heterogeneous social cohort characterized by elevated levels of motivation for learning, the impact of teaching attitude and teaching preparation on cognitive engagement is more pronounced and influential, provided 4a and 5a have been established. However, in contrast to the primary effect, the coefficient of interaction between learning motivation and teaching context on cognitive engagement does not exhibit statistical significance (B=0.092, p=0.70), hence failing to support hypothesis 6a. In the model M4, the dependent variable is emotional engagement. By including the interaction term between learning motivation and the three-dimensional teaching behavior of teachers, the R2 value of the model increased by 0.021 compared to model M3, which did not include this term. This addition also enhanced the explanatory power of the model. The regression results of M4 in Table 5 show that the interaction between learning motivation and teaching attitude has a positive and significant impact on emotional engagement (B=0.177, p<0.01), the interaction with teaching preparation has a positive and significant impact on emotional engagement (B=0.222, p<0.01), and the interaction with teaching context has a negative and significant impact on emotional engagement (B=-0.125, p<0.01), However, since the main effect of teaching context on emotional engagement is negative and not significant, hypothesis 4b and 5b are supported, while hypothesis 6b is not supported.

In the model M6, the dependent variable is the behavioral input. After adding the interaction term between learning motivation and the three-dimensional teaching behavior of teachers, the R2 value of the model increased by 0.030 compared to the M5 model, which did not include this term. This indicates that the inclusion of the interaction term improved the explanatory power of the model. The regression results of M6 in Table 5 show that the interaction between learning motivation and teaching attitude has a positive and significant impact on behavioral engagement (B=0.195, p<0.01), the interaction with teaching preparation has a positive and significant impact on behavioral engagement (B=0.267, p<0.01), and the interaction with teaching context has a negative and significant impact on behavioral engagement (B=-0.122, p<0.01). However, in terms of the impact of teaching context on behavioral engagement, it is important to note that the main effect is not significant and displays a negative trend. The presence of a moderating effect of learning motivation is observed in relation to teaching attitude, teaching preparation, and behavioral engagement. On the other hand, no moderating effect is found between teaching context and behavioral engagement. Hence, it is postulated that the hypotheses of 4c and 5c are substantiated, whereas the hypothesis of 6c is refuted.

Table 5.
Regression results of the moderating effect relationship of learning motivation.

Variable	Cognitive engagement	Cognitive engagement	Emotional engagement	Emotional engagement	Action engagement	Action engagement
	M1	M2	M3	M4	M5	M6
Gender	-0.236** (0.025)	-0.203** (0.025)	-0.276**(0.038)	-0.274**(0.029)	-0.272**(0.028)	-0.232**(0.029)
Age	0.135** (0.017)	0.099** (0.018)	0.210**(0.020)	0.150** (0.020)	0.186** (0.020)	0.125** (0.020)
Occupation category	-0.015**(0.005)	-0.012*(0.005)	-0.017**(0.006)	-0.010(0.006)	-0.021**(0.006)	-0.016**(0.006)
Income	-0.031*(0.008)	-0.035*(0.008)	0.007 (0.010)	-0.007(0.010)	-0.012(0.010)	-0.022* (0.010)
Years of service	-0.001(0.011)	0.015(0.011)	-0.068** (0.012)	-0.045** (0.012)	-0.049**(0.012)	-0.032**(0.012)
Teaching attitude	0.236**(0.042)	0.215**(0.033)	0.239** (0.033)	0.205** (0.020)	0.260**(0.034)	0.239**(0.033)
Teaching preparation	0.195**(0.054)	0.166**(0.022)	0.227** (0.062)	0.105** (0.017)	0.232** (0.033)	0.167** (0.023)
Teaching situation	0.049(0.045)	0.138(0.123)	-0.109** (0.022)	0.156** (0.021)	-0.186** (0.052)	0.213 (0.111)
Learning motivation	0.339**(0.054)	0.282**(0.089)	0.255** (0.030)	0.109** (0.018)	0.270** (0.036)	0.018(0.101)
Learning motivation * Teaching attitude		0.223**(0.032)		0.177** (0.021)		0.195** (0.020)
Learning motivation * Teaching preparation		0.211**(0.027)		0.222** (0.023)		0.267** (0.033)
Learning motivation * Teaching situation		0.092(0.051)		-0.125** (0.021)		-0.122** (0.021)
Constant term	1.343**(0.086)	2.841**(0.266)	1.837**(0.099)	3.018**(0.304)	1.767**(0.100)	3.288**(0.301)
R^2	0.451	0.469	0.433	0.454	0.449	0.479
Adjusting R^2	0.449	0.466	0.431	0.451	0.447	0.477
F	315.027**	255.697**	291.293**	239.392**	313.200**	268.086**

Note: N=1532, * p<0.05, * * p<0.01; The non-standardized regression coefficients are shown in the table, and the standard errors are shown in parentheses.

5.3.3. Hypothesis Test of Mediating Relationship

This study employed the SPSS (Statistical Package for the Social Sciences) 25.0 software for statistical analysis. Additionally, the SPSS (Statistical Package for the Social Sciences) macro provided by Preacher and Hayes [62] was utilized to establish the number of bootstraps at 5000 and to apply a deviation correction and enhancement confidence interval of 95%. The Bootstrap method was used to calculate the mediating effect of coefficient product ab and its confidence interval on learning motivation and self-efficacy. Please refer to Table 6 for the test results pertaining to the Mesomeric effect in the process of teachers' teaching attitude and its impact on the learning outcomes of adult students. The results presented in Table 6 indicate that the coefficient of cognitive input on teaching attitude and learning effect is ab1=0.0461. The 95% confidence interval for this coefficient is [0.0238, 0.0655], and it does not encompass zero. This suggests that the Mesomeric effect of cognitive input is statistically significant, providing support for hypothesis 7a. The coefficient of Mesomeric effect of emotional input, ab2, was found to be 0.0614. The 95% confidence interval for the deviation correction is [0.0338, 0.1415]. Notably, the confidence interval does not include zero, suggesting that the Mesomeric effect of emotional input is significant. Consequently, hypothesis 7b is confirmed. The coefficient ab3 of the Mesomeric effect of behavior input is determined to be 0.1226, with a 95% confidence interval for the deviation correction ranging from [0.0851, 0.2447]. The confidence interval does not include zero, indicating a significant Mesomeric effect between teaching attitude and learning effect in the context of behavior input. Hypothesis 7c has been verified. Under the influence of a multiple mediation model, the direct effect of teaching attitude on learning effectiveness is c '=0.1409, with a bias corrected confidence interval of [0.0988, 0.1720], excluding zero. The data shows that the direct effect is also significant in the mediation model. In the present study, it is seen that the variables a, b, and c possess positive values, suggesting that cognitive engagement, emotional engagement, and behavioural engagement serve as partial mediators in the relationship between teaching attitude and learning outcomes.

Table 6.
Bootstrap test of Mesomeric effect of teaching attitude.

Effect type	Route	Coefficient	Standard error	CI
Indirect effect（ab1）	Teaching attitude - Cognitive engagement - Learning effect	0.0461	0.0124	[0.0238, 0.0655]
Indirect effect（ab2）	Teaching attitude – Emotional engagement - Learning effect	0.0614	0.0213	[0.0338, 0.1415]
Indirect effect（ab3）	Teaching attitude - Action- Learning effect	0.1226	0.0208	[0.0851, 0.2447]
Total indirect effect（ab）	Teaching attitude -Learning behavior - Learning effect	0.2301	0.0223	[0.1522, 0.3365]
Direct effect（c’）	Teaching attitude - Learning effect	0.1409	0.0353	[0.0988, 0.1720]

Note: N=1532; CI=95% confidence interval, with non-standardized regression coefficients in the table.

The results presented in Table 7 show that the coefficient of cognitive input on teaching preparation and learning effect is ab1=0.0572. The 95% confidence interval for this coefficient is [0.0142, 0.0589], and it does not include zero. This suggests that the Mesomeric effect of cognitive input is significant, and hypothesis 8a is supported. The coefficient of the Mesomeric effect of emotional input, ab2, is determined to be 0.0685. The 95% confidence range for the deviation correction is calculated to be [0.0474, 0.1232]. Notably, the confidence interval does not include zero, indicating that the Mesomeric effect of emotional input holds significance. Consequently, hypothesis 8b is verified. The coefficient ab3 of the Mesomeric effect behavior input is determined to be 0.0783. The 95% confidence interval for the deviation correction is estimated to be between [0.0240, 0.1361]. The fact that the confidence interval does not include zero indicates that there is a strong Mesomeric effect of behavior input on the relationship between teaching preparation and learning outcomes. This verification of Hypothesis 8c has been confirmed. Based on the analysis employing different mediation models, it was found that the direct impact of teaching preparation on learning effectiveness was estimated to be c '=0.0630. The bias adjusted confidence interval, which excludes zero, was determined to be [0.0230, 0.1423]. The data shows that the direct effect is also significant in the mediation model. Meanwhile, the values of a, b, and c 'are both positive, indicating that cognitive engagement, emotional engagement, and behavioral engagement play a partial mediating role between teaching preparation and learning effectiveness.

Table 7.
Bootstrap test of Mesomeric effect of teaching preparation.

Effect type	Route	Coefficient	Standard error	CI
Indirect effect（ab1）	Teaching preparation - Cognitive engagement - Learning effect	0.0572	0.0177	[0.0142，0.0589]
Indirect effect（ab2）	Teaching preparation – Emotional engagement - Learning effect	0.0685	0.0163	[0.0474，0.1232]
Indirect effect（ab3）	Teaching preparation - Action- Learning effect	0.0783	0.0206	[0.0240，0.1361]
Total indirect effect（ab）	Teaching preparation -Learning behavior - Learning effect	0.2040	0.0223	[0.0987，0.3109]
Direct effect（c’）	Teaching preparation - Learning effect	0.0630	0.0182	[0.0230，0.1423]

Note: N=1532; CI=95% confidence interval, with non-standardized regression coefficients in the table.

The results of the masking effect test in the process of teachers' teaching situations affecting the learning effectiveness of diverse student sources are shown in Table 8. The data results in Table 8 show that the effect coefficient of cognitive input in teaching situations and learning effects is ab1=0.0178, the 95% deviation correction confidence interval is [-0.0908, 0.1504], and the confidence interval includes zero, indicating that the Mesomeric effect of cognitive input is not significant and the hypothesis 9a is not tenable. The coefficient of the Mesomeric effect of emotional input ab2=-0.0093, the 95% deviation correction confidence interval is [-0.3551, 0.3124], and the confidence interval includes zero, indicating that the Mesomeric effect of emotional input is not significant, its masking effect does not exist, and hypothesis 9b has not been verified. The mesomeric effect coefficient of behavior input ab3=-0.0205, the 95% deviation correction confidence interval is [-0.1844, 0.1668], and the confidence interval includes zero, indicating that the mesomeric effect of behavior input between the teaching situation and the learning effect is not significant, the supposed masking effect also does not exist, and the hypothesis 9c is not supported.

Table 8.
Bootstrap test of Mesomeric effect of teaching situation.

Effect type	Route	Coefficient	Standard error	CI
Indirect effect（ab1）	Teaching situation - Cognitive engagement - Learning effect	0.0178	0.0574	[-0.0908，0.1504]
Indirect effect（ab2）	Teaching situation – Emotional engagement - Learning effect	-0.0093	0.1640	[-0.3551，0.3124]
Indirect effect（ab3）	Teaching situation - Action-Learning effect	-0.0205	0.0780	[-0.1844，0.1668]
Total indirect effect（ab）	Teaching situation -Learning behavior - Learning effect	-0.0120	0.2220	[-0.4163，0.4244]
Direct effect（c’）	Teaching situation - Learning effect	0.0782	0.0277	[0.0239，0.1325]

6. Conclusion and Discussion

6.1. Theoretical Contributions

This study initially investigates the correlation between teaching behavior exhibited by instructors, student participation in learning activities, and their learning outcomes within the context of adult education utilizing the Blended learning teaching mode. Furthermore, it aims to broaden the scope of Blended learning mode. This study measures the relevant hypothesis relationships in the research model by using a survey questionnaire on the perception of teacher teaching behavior, learning engagement, and learning effectiveness among adult student groups in a blended learning environment. The findings suggest that both teaching attitude and preparation play a crucial role in enhancing the three dimensions of learning engagement. However, it is worth noting that teaching context only has a significant positive influence on cognitive engagement, while its impact on emotional and behavioral engagement is not statistically significant. The results indicate that teacher teaching behavior is still a key factor in promoting students' learning engagement. However, it is important to take into account several elements when considering the teaching behaviors that should be employed to enhance students' involvement in learning. This conclusion is consistent with the conclusion that teaching behavior in traditional classrooms and in virtual classrooms positively affects students' learning engagement [10]. However, the design of teaching contexts plays a crucial role in facilitating the cognitive input required for strategy application and self-management. When effectively designed, these contexts can promote the learning perception of students with diverse backgrounds. However, it is important to note that an overly complex and cumbersome plot design may not always elicit emotional identification and behavioral initiative in students. This also shows that Blended learning is not just a simple combination of online and face-to-face teaching organization forms but a multi-aspect integration of teaching methods, teaching locations, and technical means [63].

In the process of Blended learning, teachers should not only play the roles of guidance, inspiration, supervision, and management, but they should also prioritize the cultivation of students' initiative and excitement in the pursuit of learning objectives. [64]. The research results provide a reference for teachers to pay attention to the types of student engagement in teaching behavior. Educators have the ability to effectively employ many instructional strategies in order to enhance student involvement across multiple domains, aligning with distinct curriculum objectives. For instance, employing pedagogical planning can foster active learning by including a wide range of student resources, facilitating contact and collaboration among peers, and so forth. Furthermore, the examination of the moderating influence of diverse student learning motivations on teachers' instructional practices and student engagement enhances the conclusions derived from adult education theory. The test results from the examination of the moderating effect of learning motivation on various dimensions of teacher teaching behavior and the learning engagement of students from various backgrounds show that all positive moderating effects, with the exception of the moderating effect between teaching context and learning engagement in three dimensions, are statistically significant. This shows that diversified students with high learning motivation and self-efficacy usually have clear learning needs and have strong confidence in their ability to complete the established learning tasks. In the Blended learning approach, students exhibit a heightened awareness of teachers' teaching attitude and degree of preparation. Consequently, they are inclined to devote a greater amount of effort to their learning, resulting in a higher level of academic achievement.

The results of the research align with the comprehensive evaluation of the learning performance of a group of students who exhibit distinct motivating requirements for learning activities in teaching practice. This result provides further support for the humanistic teaching theory, which focuses on students' learning ability and desire tendency in educational activities, as well as the constructivist learning theory, that focuses on students' active role and agency in knowledge construction. This statement pertains to the adult education theory that emphasizes the significance of diverse adult groups' job experience and roles. Additionally, it discusses the ramifications of applying adult education theory to this particular group. The moderating effect of learning motivation on teaching context and learning engagement is not significant. This demonstrates that, in comparison to traditional face-to-face instruction and online teaching, the Blended learning approach has acquired a somewhat higher level of complexity in accommodating diverse pupils. If teaching circumstances are designed based on this premise , learners may perceive these practices as redundant and experience an additional cognitive load in their learning process [65]. Despite possessing a strong inclination towards learning, individuals may nevertheless perceive the instructional settings as inadequate. In such instances, it becomes imperative to shift the emphasis of teaching towards content delivery and fostering knowledge inspiration. This study examines the problems that require careful attention during the implementation of Blended learning in the context of adult education. It also evaluates the effectiveness of incorporating diverse Blended Learning models from the perspective of adult learners.

This study ultimately examines the impact of teachers' teaching behaviour on learning outcomes by analyzing students' participation in the learning process. It also contributes to the existing body of research on the relationship between teaching behaviour and students' engagement in Blended learning. This study analyzes the mediating effect of diversified student source learning engagement between teacher teaching behavior and learning effectiveness. It shows that there is no discernible relationship between teaching contexts and students' learning effectiveness as mediated by learning engagement. The mediating effect of teaching attitude and teaching preparation on learning effectiveness through learning engagement is significant. The results show that certain teaching behaviors exhibited by educators can improve the effect of Blended learning by facilitating the acquisition of knowledge and skills among a diverse student population. In view of the current dearth of research regarding the impact of teaching behavior within the Blended learning model on the learning input of a diverse student population in higher vocational education, this study provides a theoretical contribution by addressing the design of appropriate teaching behavior within the Blended learning model. The aim is to enhance learning outcomes by improving specific dimensions of learning input.

The teaching attitude and preparation of teachers have a significant impact on learning outcomes through the three-dimensional mechanism of learning engagement. This demonstrates that, in contrast to the traditional approach of solely relying on face-to-face teaching or online learning, where teachers and students are physically separated, blended learning offers a combination of both methods to mutually complement each other. This allows teachers to properly use face-to-face and online communication as needed, providing students with comprehensive academic support across various domains of learning [66]. These supports can be derived from the attitudes of teachers towards Blended learning and their perception of teaching preparation during the implementation of the teaching process. These supports also have an impact on students' focus on learning tasks and in-depth comprehension, and they can be resolved quickly through various forms of support when students encounter difficulties in learning. Students' emotional attachment to learning is evident, and as their degree of involvement increases, they eventually develop self-management and self-monitoring learning behaviors that significantly enhance learning outcomes. Although the three dimensions of learning engagement are separate, they intersect in the actual learning process. The research findings offer useful theoretical references for designing teacher behaviour in the classroom for both the larger student body and the adult population that follows from the growth.

6.2. Practical Enlightenment

This study provides certain educational practice guidance and corresponding references for the expanded adult population and subsequent adult education. As an adult group, adult students who have expanded their enrollment in higher vocational colleges appear more mature in terms of mentality and personality and behave more independently than full-time students who study after work. The significance lies in the fact that the individuals in question fulfil not only the role of students but also assume responsibilities associated with employment and family obligations. In an age of scientific and technical advancement, people get more familiar with the direction their careers are taking and have a better grasp of their self-actualized ideals as a result of their increasing work experience and ongoing life improvement, and they also show more independence in learning [67]. Therefore, adult students have a stronger willingness to participate in the expanded enrollment of academic education, and they are more willing to engage in self-learning. Adult students are naturally more likely to accept flexible learning methods because they are groups with roles and work experience. They also tend to actively participate in interactive learning activities where they share learning content with teachers and other students, as well as express their opinions and understanding of the material being learned. Therefore, in the process of blended learning, diversified adult students are no longer simply recipients of knowledge but active participants in the learning process.

However, under the current educational framework, adult education is often perceived as a supplementary kind of learning that goes beyond traditional higher education. Consequently, the effectiveness of adult education methods in facilitating personal growth and improvement for adults is often not recognized. In specific teaching activities, it is generally carried out in the form of general education. However, under the current educational framework, adult education is sometimes perceived as a supplementary kind of learning that goes beyond traditional higher education. Consequently, the effectiveness of adult education methods in facilitating personal growth and improvement for adults is often not recognized. In the course design, *the selection of teaching resources and the arrangement of teaching activities* reflect a teaching attitude and principle centered on them. This study shows that teachers' teaching attitude and teaching preparation in the process of Blended

learning have a positive and significant impact on the learning effect of diversified students. Teachers should reconsider their traditional perspectives on knowledge development and innovation, acknowledging the significant advancements in teaching methods brought about by the digital era. They should reassess their roles and responsibilities as educators, adopting a proactive approach to continuous learning. This entails transitioning from a position of authority in the classroom to becoming active participants in the teaching process. Furthermore, teachers should transform their traditional role of simply imparting knowledge to that of guides of students with diversified backgrounds and different learning experiences, developers of courses with some innovative and attractive characteristics, organizers of a group, as well as designers of their own teaching contents. [68]. Ultimately, it aims to encourage self-learning among adult students, providing them with corresponding conditions and assistance for self-realization. By accommodating the unique attributes and diverse self-actualization of individuals, this approach facilitates the fulfillment of educational prerequisites encompassing vocational training, knowledge augmentation, skill development, and academic attainment. Consequently, it enables the successful integration of vocational education and adult education within the realm of academic instruction.

The effectiveness of learning engagement indicates that education and teaching are continuous internalization processes that require teachers and students to jointly accumulate knowledge and emotions at each teaching stage. In a blended learning environment, another way to promote the learning input of diverse students is to enhance the interactive design preparation of classroom teaching [69]. Through the implementation of interactive classroom teaching activities, our aim is to promote the level of learning engagement of diverse students by encouraging their active participation in the course and fostering their diverse interactions with teachers, classmates, the learning content, and the teaching environment. We pay full attention to classroom summaries, guide them to reflect and ask questions, and help them construct meaning for new knowledge based on prior knowledge and experience, thereby increasing their level of learning engagement. Furthermore, educators have the opportunity to gather a substantial quantity of instructional feedback data through the participatory learning of a diverse and interactive student body. This enables them to continuously adapt their teaching methods and course material, thereby enhancing student engagement and fostering a more effective learning process. Consequently, this establishes a positive feedback loop that contributes to the improvement of blended learning outcomes for adult learners with diverse backgrounds. The majority of adult students come from the frontlines of professional positions. Individuals go for vocational education with the intention of improving their occupational skills, work adaptability, fulfilling their personal development goals, and realizing their life value. The theory of self-actualization education is proposed to encourage learners to stimulate their internal learning motivation and achieve the goal of self-actualization through their free learning choices. From the perspective of employment or reemployment, they must have their own clear learning goals and motivations when entering vocational colleges through enrollment expansion [70].

Based on a social practice standpoint, it may be argued that individuals possess knowledge, technical abilities, and experience that are more advanced and applicable in certain aspects compared to lecturers in vocational colleges. However, vocational colleges primarily prioritize vocational education as the driving force behind the expansion of enrollment in diversified adult education. This emphasis is centered on "utilitarian learning" in terms of curriculum or technical skill development. However, this approach somewhat neglects the practical learning requirements of diverse students and ignores the original motivation that led them to pursue vocational education. From the perspective of learning motivation, when designing teaching organization activities and preparing teaching resources, teachers need to consider the learning needs and individual learning characteristics of diverse students, and they should continuously promote their motivation level to complete various teaching tasks while maintaining initial learning motivation in the teaching content. The results of this study show that learning motivation can positively regulate the relationship between teachers' teaching attitude, teaching preparation and the learning effect of diversified students in Blended learning. This requires teachers to not only consider the practical learning needs of diverse students in teaching practice, but it is imperative for educators to additionally prioritize the cultivation of students' intrinsic motivation towards the successful completion of learning tasks, in addition to the provision of relevant resources and information pertaining to those tasks. In the process, they should provide effective guidance and feedback to students in a timely manner and give clear recognition to their learning ability and level of effort in order to increase students' sense of learning achievement and confidence to maintain their continued learning motivation [71]. Simultaneously, it is imperative for educators to emphasize the significance and applicability of task design within the context of curriculum-based learning. Teachers can raise students' learning motivation and promote their active engagement in learning by satisfying the different learning needs of students and positively impacting their career or self-improvement.

6.3. Research Limitations and Future Prospects

This study examines the impact of diversified student sources on blended learning in the context of higher vocational enrollment expansion. It adopts an empirical approach and employs theoretical deduction to construct a model that explains the learning effects of diversified student sources in a blended learning environment. The study formulates hypotheses based on this model and collects primary data through questionnaires for empirical testing. Most of the hypotheses in this study have been validated by data, but due to limitations in research conditions and data sample content, there are still many shortcomings in this study, which are specifically manifested in the following three aspects:

The research lacks thorough coverage of teaching behaviour characteristics due to restrictions in research scope and article length.

The variables of teachers' teaching behavior in this study mainly examine their specific implementation of Blended learning from the three dimensions, including teachers' attitude, preparation, and situation. Although these three dimensions cover the main aspects of teachers in the process of Blended learning, there still exist scenarios in which the partitioning of dimensions lacks sufficient specificity and the measurement fails to provide a full assessment. If the designed teaching

behavior is more comprehensive, specific teaching behavior indicators can be used in the data validation process to provide more targeted guidance for actual teaching practices. However, in this study, we focus on verifying the impact mechanism of the learning effect of diversified students under the Blended learning model. The detailed indications, which may not align with the research parameters established by the study, have been excluded from the overall analysis based on the specific factors provided. In the subsequent research process, teaching behavior can be divided into detailed dimensions based on the actual situation, such as designing and organizing teaching, promoting activity participation, direct guidance, online interaction, feedback and evaluation, and emotional support [13]. The primary objective is to carefully choose the essential variables that are relevant to the analysis in accordance with the specific study context and issue. This study uses a questionnaire survey method for variable evaluation, which has some drawbacks compared to actual objective data.

Although this research has verified the proposed hypothesis through the method of quantitative empirical research. The purpose of collecting research data and evaluating variables is solely to get insight into students' subjective perceptions of the Blended learning experience, which is achieved by the administration of questionnaire surveys. Similarly, the evaluation of teachers' instructional practices serves the same purpose. While this approach successfully addresses the issue of data aggregation, it is constrained by the subjective bias inherent in the collection object as well as the collection method, scope, and timeframe. Consequently, it is unable to fully capture and analyze the authentic learning process data of a diverse student population. The data results may not be sufficient to reveal the causal relationship between variables to a certain extent. Due to the accessibility of students' online learning traces and evaluation in the Blended learning environment, future research can adopt the objective data collection method of combining online and offline data. The collection of data on teachers' teaching behavior is also carried out using ordinal scoring data. Furthermore, the internal influence mechanism of variables such as teachers' teaching behavior, students' learning investment, and learning effect is examined through the aggregation of data from both teachers and students. In future studies, it is recommended to undertake further teaching cycle practices in order to gather a more comprehensive dataset that can successfully validate the hypothesized model relationships. Due to limitations in research conditions, there is still a certain gap between the research sample and the analogy of adult education.

This study selected three different types of vocational colleges for sample data collection. Although the collected samples met the requirements, they were affected by factors such as manpower, technology, and time. The data showed an imbalance in the categories of income, age, and occupation of students. The observed imbalance does not appear to have a significant impact on the analysis. However, it is important to consider that the data collection process may introduce a certain bias, thereby potentially limiting the portability of the study's findings. Moreover, the enrollment expansion policy for higher vocational education will end in 2022. In order to extend the applicability of the research findings to the realm of academic continuing education or adult education, it is necessary to broaden the age range of the data under consideration. In future studies, it is possible to address the constraint of limited student sources in the expansion of higher vocational education enrollment by broadening the sample data to include academic continuing education or adult education groups that utilize blended learning. This would enhance the representativeness of the sample and facilitate the collection of more comprehensive data. Moreover, it would enable the dissemination of research findings to a wider audience, thereby fostering greater impact.

7. Conclusion

This study explores the response to blended learning and its learning effect among adult groups in higher vocational education. Because the blended learning model has become the real demand of adult groups in higher vocational education enrollment expansion, the present study aims to develop a model that elucidates the influence mechanisms of the learning effects of diverse students in the context of blended learning. This model is based on the relationship between “teacher behaviour, learning engagement, and the learning effect”. The study framework includes the learning motivation and self-efficacy of adult students and provides a comprehensive analysis of the practical learning needs that teachers should consider when instructing diverse students in a blended learning environment, particularly in the context of higher vocational enrollment expansion. The relationship between learning engagement and its learning effect is generated under the influence of learning engagement. This study examines the external and internal mechanisms that influence the learning effects of diverse students in a blended learning environment, utilizing data obtained from a questionnaire survey. This study clarifies the relationship between teaching behaviour and learning input, which can enable educators to implement mixed teaching according to its foundation and pertinence before skillfully modifying blended learning as a teaching technique. In addition, foster the theoretical development and implementation of talent training in higher vocational education by deepening the understanding and reasoning behind the talent training model of expanded enrollment in higher vocational colleges, enhancing the theory of talent training for expanded enrollment groups with diverse roles, and proposing the blended learning theory for expanded enrollment in a creative way.

References

[1] K. Li, "2020 government work report," Retrieved: http://www.gov.cn/premier/2020-05/29/content_5516072.htm. 2020.

[2] D. Jiang, "On the great changes and new positions brought by the expansion of higher vocational education enrollment to vocational education," *China Vocational and Technical Education,* vol. 10, pp. 5-11, 2019.

[3] X. Liu and L. Wankun, "Challenges and responses to the development of higher vocational education against the background of expanding enrollment by one million," *Education and Career,* vol. 14, pp. 5-11, 2019.

[4] J. a. Liu, Z. Chen, and M. Y. Li, "Expansion of higher vocational education enrollment: A case study of allocation of educational resources from a social governance perspective," *China Higher Education Research,* vol. 4, pp. 6-9, 2019.

[5] B. Fang, "Self-directed learning: An effective path for adult learning," *Educational Exploration,* vol. 8, pp. 57-58, 2011.

[6] G. Lan, J. Wei, C. Huang, Y. Zhang, Y. He, and X. Zhao, "Learning metaverse enabling education: Building a new pattern of "intelligence+" educational application," *Journal of Distance Education,* vol. 02, pp. 35-44, 2022.
[7] D. R. Garrison and H. Kanuka, "Blended learning: Uncovering its transformative potential in higher education," *The Internet and Higher Education,* vol. 7, no. 2, pp. 95-105, 2004.
[8] M. G. Brown, "Blended directive practice: A review of the empirical quality on instructors' option and use of online tools in face to face teaching," *The Internet and Higher Education,* vol. 31, pp. 1-10, 2016.
[9] B. Liu, W. Zhang, and J. Liu, "Research on the impact of teacher support on online student learning engagement," *Research on Electronic Education,* vol. 11, pp. 63-68, 2017.
[10] H. Zhao and J. Chen, "A survey of teaching behavior, learning engagement, and learning outcomes in university classrooms from a student perspective," *Exploring Higher Education,* vol. 03, pp. 37-42, 2018.
[11] P. Shea, C. S. Li, and A. Pickett, "A study of teaching presence and student sense of learning community in fully online and web enhanced college courses," *The Internet and Higher Education,* vol. 9, no. 3, pp. 175-190, 2006.
[12] N. Pellas, "The influence of computer self-efficacy, metacognitive self-regulation and self-esteem on student engagement in online learning programs: Evidence from the virtual world of second life," *Computers in Human Behavior,* vol. 35, pp. 157-170, 2014. https://doi.org/10.1016/j.chb.2014.02.048
[13] Y. Zhang, "Research on the impact of teachers' teaching behavior on college students' learning engagement in the Blended learning environment," Master's Thesis, Liaoning Normal University, 2022.
[14] S. Bi, "Realistic challenges and response strategies for the rapid expansion of higher vocational education enrollment—also on the scale development of higher vocational education," *China Vocational and Technical Education,* vol. 10, pp. 15-20, 2019.
[15] K. Malcolm, *Modern adult education practice*. Beijing: People's Education Press, 1989.
[16] H. Hou and X. Wang, "Analysis of "Adult education"," *Journal of College of Adult Education, Hebei University,* vol. 01, pp. 5-14, 2020.
[17] X. Li, D. Xu, and X. Geng, "Re exploration of the concept of adult education," *Journal of Hebei Normal University: Education Science Edition,* vol. 02, pp. 40-44, 2015.
[18] Y. Zhang and M. Zhu, "Opportunities, themes, and trends in the development of adult education in the new era," *Nanjing Social Sciences*, vol. 12, pp. 150-156, 2019.
[19] L. Sun and C. Le, "Evolution and reflection: 70 years of theoretical research on adult education," *Education Research,* vol. 05, pp. 123-132, 2019.
[20] M. Wang, "Innovative exploration of adult education teaching models for blended learning," *Journal of Huainan Vocational and Technical College,* vol. 01, pp. 74-76, 2023.
[21] T. Anderson, L. Rourke, D. R. Garrison, and W. Archer, "Assessing teaching presence in a computer conferencing context," *Journal of Asynchronous Learning Networks,* vol. 5, no. 2, pp. 1-18, 2001. https://doi.org/10.24059/olj.v5i2.1875
[22] L. Sun, "A study on the intervention of college students' learning engagement in the Blended learning environment," Doctoral Dissertation, Northeast Normal University, 2022.
[23] D. H. Lim and H. Kim, "Motivation and learner characteristics affecting online learning and learning application," *Journal of Educational Technology Systems,* vol. 31, no. 1, pp. 423-439, 2003.
[24] B. Xu, "The theory of student engagement in higher education: Connotation, characteristics, and applications," *Higher Education Research,* vol. 34, no. 06, pp. 48-54, 2013.
[25] S. R. Jimerson, E. Campos, and J. L. Greif, "Toward an understanding of definitions and measures of school engagement and related terms," *The California School Psychologist,* vol. 8, no. 1, pp. 7-27, 2003. https://doi.org/10.1007/bf03340893
[26] J. A. Fredricks, P. C. Blumenfeld, and A. H. Paris, "School engagement: Potential of the concept, state of the evidence," *Review of Educational Research,* vol. 74, no. 1, pp. 59-109, 2004. https://doi.org/10.3102/00346543074001059
[27] C. R. Greenwood, "The case for performance based instructional models," *School Psychology Quarterly,* vol. 11, no. 4, pp. 283-292, 1996.
[28] B. J. Zimmerman, "Attaining self-regulation: A social cognitive perspective In handbook of self-regulation." San Diego, CA: Academic Pressure, 2000, pp. 13-39.
[29] L. Niu, "Application of adult learning motivation theory in online distance education," *China Electronic Education,* vol. 09, pp. 34-37, 2004.
[30] W. M. Williams, R. J. Sternberg, C. A. Rashotte, and R. K. Wagner, "Assessing the value of cooperative education," *Journal of Cooperative Education,* vol. 28, no. 2, pp. 32-55, 1993.
[31] M. Leenknecht, L. Wijnia, M. Köhlen, L. Fryer, R. Rikers, and S. Loyens, "Formative assessment as practice: The role of students' motivation," *Assessment & Evaluation in Higher Education,* vol. 46, no. 2, pp. 236-255, 2021.
[32] G. M. Sinatra, B. C. Heddy, and D. Lombardi, "The challenges of defining and measuring student engagement in science," *Educational Psychologist,* vol. 50, no. 1, pp. 1-13, 2015.
[33] H. T. Emerson and R. E. Millsap, "Beyond individual differences: Exploring school effects on SAT scores," *Educational Psychology*, vol. 39, no. 3, pp. 157-172, 2004.
[34] D. J. Shernoff, *The experience of student engagement in high school classrooms: Influences and effects on long term outputs*. LAP Lambert Academic Publishing, 2010.
[35] S. G. M. Delialioglu, B. C. Heddy, and D. Lombardi, "The challenges of defining and measuring student engagement in science," *Educational Psychologist,* vol. 50, no. 1, pp. 1-13, 2015.
[36] J. Wang, S. Yuan, and G. Zhao, "The impact of blended teaching on the learning effectiveness of college students: An empirical study based on the application of MOOC in first class universities in China," *Modern Distance Education,* vol. 05, pp. 39-47, 2018.
[37] M. Chen, "Research on the learning engagement status and influence mechanism of college students under the mixed teaching mode," *Journal of Jinzhong College,* vol. 05, pp. 96-102, 2022.
[38] Y. Wang, H. Peng, and R. Huang, "Development and application of a distance student learning motivation measurement tool," *Open Education Research,* vol. 05, pp. 74-78, 2006.
[39] D. R. Garrison and N. D. Vaughan, *Blended learning in higher education: Framework, principles, and guidelines*. San Francisco, CA: Jossey-Bass, 2008.
[40] D. Peng, *General psychology*, 5th ed. Beijing: Beijing Normal University Press, 2019.

[41] B. J. Zimmerman, A. Bandura, and M. Martinez Pons, "Self-motivation for academic attachment: The role of self-efficacy beliefs and personal goal setting," *American Educational Research Journal,* vol. 29, no. 3, pp. 663-676, 1992.
[42] A. Bandura, "Self-efficacy mechanism in human agency," *American Psychologist,* vol. 37, no. 2, pp. 122-147, 1982.
[43] C. A. Wolters and M. B. Benzon, "Assessing and predicting college students' use of strategies for the self-regulation of motivation," *The Journal of Experimental Education,* vol. 81, no. 2, pp. 199-221, 2013. https://doi.org/10.1080/00220973.2012.699901
[44] M. Schwinger and J. Stiensmeier-Pelster, "Effects of motivational regulation on effort and achievement: A mediation model," *International Journal of Educational Research,* vol. 56, pp. 35-47, 2012. https://doi.org/10.1016/j.ijer.2012.07.005
[45] I. Fritea and R. Fritea, "Can motivational regulation counteract the effects of boredom on academic achievement?," *Procedia-Social and Behavioral Sciences,* vol. 78, pp. 135-139, 2013. https://doi.org/10.1016/j.sbspro.2013.04.266
[46] A. D. Liem, S. Lau, and Y. Nie, "The role of self-efficacy, task value, and achievement goals in predicting learning strategies, task disengagement, peer relationship, and achievement outcome," *Contemporary Educational Psychology,* vol. 33, no. 4, pp. 486-512, 2008. https://doi.org/10.1016/j.cedpsych.2007.08.001
[47] F. Wu and Q. Zhang, "Learning behavioral engagement: Definition, analysis framework and theoretical model," *China Educational Technology,* vol. 372, no. 1, pp. 35-41, 2018.
[48] M. Ronimus, J. Kujala, A. Tolvanen, and H. Lyytinen, "Children's engagement during digital game-based learning of reading: The effects of time, rewards, and challenge," *Computers & Education,* vol. 71, pp. 237-246, 2014. https://doi.org/10.1016/j.compedu.2013.10.008
[49] H. Wen and S. Mu, "How can different paths lead to the same goal—— Analysis of the practical effects of mixed teaching with different complexities," *Distance Education in China,* vol. 02, pp. 64-72, 2023.
[50] J. Gao, "The impact of online academic emotions on learning engagement from the perspective of social cognitive theory," *Open Education Research,* vol. 22, no. 2, pp. 89-95, 2016.
[51] J. Ma, X. Han, J. Yang, and J. Cheng, "Examining the necessary condition for engagement in an online learning environment based on learning analytics approach: The role of the instructor," *The Internet and Higher Education,* vol. 24, pp. 26-34, 2015. https://doi.org/10.1016/j.iheduc.2014.09.005
[52] P. McGee and A. Reis, "Blended course design: A synthesis of best practices," *Journal of Asynchronous Learning Networks,* vol. 16, no. 4, pp. 7-22, 2012.
[53] J. Korr, E. B. Derwin, K. Greene, and W. Sokoloff, "Transitioning an adult serving university to a blended learning model," *The Journal of Continuing Higher Education,* vol. 60, no. 1, pp. 2-11, 2012.
[54] R. Boelens, B. De Wever, and M. Voet, "Four key challenges to the design of blended learning: A systematic literature review," *Educational Research Review,* vol. 22, pp. 1-18, 2017. https://doi.org/10.1016/j.edurev.2017.06.001
[55] M. Jing, "Research on the influence mechanism of college students' learning engagement in a mixed teaching environment - from the perspective of teaching behavior," *Chinese Distance Education,* vol. 02, pp. 57-67, 2020.
[56] G. H. Wang, "Research on the influence of college students' characteristics on the mixed learning effect of online and offlinet," 2020.
[57] M. Xu, "Research on teaching interaction model promoting knowledge construction in blended learning," Doctoral Dissertation, Shanxi Normal University, 2020.
[58] F. Wu and C. Wang, "Comparison of measurement of students' online learning motivation under five different modes," *Modern Distance Education Research,* vol. 01, pp. 78-84+95, 2016.
[59] G. Cheng and J. Chau, "Exploring the relationships between learning styles, online participation, learning achievement and course satisfaction: An empirical study of a blended learning course," *British Journal of Educational Technology,* vol. 47, no. 2, pp. 257-278, 2016. https://doi.org/10.1111/bjet.12243
[60] L. Jiang, X. Han, and J. Cheng, "Analysis and research on the characteristics and learning effectiveness of MOOCs students," *China's Audiovisual Education,* vol. 11, pp. 54-65, 2013.
[61] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research,* vol. 18, no. 1, pp. 39-50, 1981.
[62] K. J. Preacher and A. F. Hayes, "Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models," *Behavior Research Methods,* vol. 40, no. 3, pp. 879-891, 2008. https://doi.org/10.3758/brm.40.3.879
[63] R. a. R. Mason, F., *E-learning: The key concepts*. Abingdon Great Britain: Routlege, 2006.
[64] K. He, "Looking at the new development of educational technology theory from blending learning," *Research on Audiovisual Education,* vol. 3, pp. 10-15, 2004.
[65] S. McCallum and M. M. Milner, "The effectiveness of formative assessment: Student views and staff reflections," *Assessment & Evaluation in Higher Education,* vol. 46, no. 1, pp. 1-16, 2021. https://doi.org/10.1080/02602938.2020.1754761
[66] S. Zhang, Q. Gao, Y. Wen, M. Li, and Q. Wang, "Automatically detecting cognitive engagement beyond behavioral indicators," *Educational Technology & Society,* vol. 24, no. 2, pp. 58-72, 2021.
[67] E. Yang, "Exploring the ways to improve vocational skills for students enrolled in higher vocational colleges - taking guangzhou c vocational college as an example," *Journal of Ningbo Vocational and Technical College,* vol. 06, pp. 65-71, 2022.
[68] M. Xu, "Research on teaching interaction model promoting knowledge construction in blended learning," Master's Thesis, Northwest Normal University, 2022.
[69] C. Zhao, "Research on blended learning engagement of college students based on learning analysis technology," Doctoral Dissertation, East China Normal University, 2021.
[70] L. Miao, X. Liu, M. Yang, and T. Li, "Research on the construction of informationization and structured "double teacher" teaching teams against the background of million enrollment expansion," *Shaanxi Education (Higher Education),* vol. 05, pp. 74-76, 2023.
[71] X. Chang, J. Zu, W. Li, and F. Dan, "Research on the influence of task types on Blended learning engagement," *China Education Informatization,* vol. 05, pp. 121-128, 2022.