

Research on the Learning Engagement of University Students in a Blended Learning Environment

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Abstract: Nowadays, the blended learning model, which integrates "Intelligent+" technology, has become an important development direction in higher education. In this study, the BOP-ABC model was constructed and SPSS was employed for simulation experiments on the cases. The results show that the learning engagement is affected by both subjective and objective factors, which involve three dimensions: students, teachers, and external environment. Improving the input of all parties can effectively enhance the level of students' learning engagement.

Keywords: Blended learning model; Learning engagement; University students; BOP-ABC

1. Introduction

With the improvement of social and economic levels and the rapid development of the information age, the blended teaching model, which integrates "Internet+" and "Intelligent+" technologies, has become an important development direction for higher education in China and around the world. By constructing a BOP-ABC model of learning engagement for students in higher education institutions and using SPSS software to conduct simulation experiments on the cases. The results show that learning engagement is affected by two main aspects, subjective and objective factors, which involve three dimensions: students, teachers, and the external environment. Transforming the teaching methods of teachers, strengthening interaction and feedback, and improving various aspects of the blended teaching model in higher education institutions can effectively enhance students' learning engagement.

In 2022, Jiangsu Province launched a grassroots teaching organization construction project for higher education institutions, introducing ten measures to promote teaching capacity improvement and ten standards for grassroots teaching organization construction. These measures emphasize the standardization of online teaching and assessment methods, the innovation of grassroots teaching organization carriers and operation methods, and the importance of exploring the construction standards, construction paths, and operation modes of new grassroots teaching organizations in the "Intelligent+" era. In December 2022, the report "Infinite Possibilities—Digital Development of World Higher Education" pointed out that "since the 21st century, a new round of technological revolution and industrial transformation has brought unprecedented development opportunities, and digital knowledge, information, and data have become key factors of production." Promoting the transformation and upgrading of classrooms, leveraging the advantages of blended learning models in time and space, and promoting the comprehensive development of people are important directions for higher education reform in the new era [1].

2. Research background and purpose

Blended learning model is a combination of internet resources, information technology resources, and traditional classroom teaching resources. It enables teachers to play a leading role in guiding and inspiring students in the classroom while fully reflecting the initiative and enthusiasm of students in learning. In February 2020, the Ministry of Education advocated that universities should make full use of online teaching resources to ensure teaching progress and online teaching quality during the epidemic prevention and control period, achieving "no suspension of teaching and learning despite the suspension of classes". In 2021, the "Shanghai Education Digital Transformation Implementation Plan (2021-2023)" was released, proposing that by 2023, Shanghai would become a national benchmark for education digital transformation. With the accelerating integration of digital technology and education, blended online and offline teaching has gradually evolved from an emergency mode during the epidemic to the new norm of smart teaching in universities. How to further innovate and break through

this model is a topic of widespread concern in society. In fact, the enthusiasm of higher education for blended teaching is affected by subjective and objective factors, making it face more severe practical constraints during blended teaching activities. [2]

At present, research on blended learning models mainly focuses on the development of educational technology and the improvement of teaching quality. The focus is on evaluating the impact of blended learning on student academic performance, learning experience, and teacher teaching effectiveness. Existing studies have found that differences in dimensions such as student performance, teacher feedback, and student and teacher participation can affect the pros and cons of blended learning models. The theoretical basis and research hypothesis of the BOP-ABC model are derived from social learning theory, which describes the influence of environmental factors on individual behavior. The model originates from the participatory teaching model BOPPPS developed and promoted by the Instructional Skills Workshop (ISW) in Canada, combined with Davis's ABC model. The BOP-ABC teaching model includes introduction (Bridge in), clarification of learning objectives or expected outcomes (Objective or outcomes), participatory learning (Participation), antecedent (Antecedent), behavior (Behavior), and consequence (Consequence). In this study, university students in Shanghai during the 2022-2023 academic year are selected as research subjects, and the BOP-ABC model is used to measure students' learning engagement. SPSS software is used to perform simulation experiments on instances, exploring the effects of subjective and objective factors in blended learning from the perspective of innovation in teaching models and the inclusion of students' learning motivation.[3]The research finds: first, digital literacy and ability are important factors affecting student learning engagement in blended learning models, and the improvement of digital usage ability helps to strengthen students' learning engagement; this conclusion remains robust after the validity test and sensitivity analysis of the model; second, the transformation of teacher roles and changes in guidance methods are important factors affecting student learning engagement, manifested as various teaching strategies helping students better understand and master course content; third, under the conditions of strong student self-regulation ability and high adaptability of teachers, a stable external environment will enhance students' learning enthusiasm, and the driving effect on their learning engagement is more apparent.

3. Systematic Analysis of Students' Learning Engagement under the Blended Learning Model

3.1. Influencing factors of university students' learning engagement

(1) From the student's perspective, digital literacy and skills are important factors that influence student engagement in a blended learning environment. During the online learning process, students need to have a certain level of digital skills in order to quickly adapt to online platforms and utilize various innovative learning resources. A lack of digital skills may lead to resistance and fatigue toward online teaching methods, thereby reducing student engagement. In addition, compared to traditional teaching, blended learning requires higher self-management skills from students. Students need to take more control of their learning plans and progress while continuously inspiring their own enthusiasm and interest in learning, maintaining a high level of engagement.

(2) From the teacher's perspective, the transformation of the teacher's role and changes in guidance methods are important factors that influence student engagement. In a blended learning environment, teachers need to take on more of a guiding and coordinating role. University students need to participate in more independent innovation and practice, with teachers providing necessary guidance and assistance. In blended learning, teachers often plan online classroom activities for students, design personalized assignment requirements, and evaluate students' online learning outcomes. These diverse guidance methods affect students' learning initiative and thus become important factors in changing the level of student engagement. At the same time, compared to traditional teaching, teacher-student interaction in blended learning is more flexible and diverse. The interaction and trust between teachers and students have a significant impact on student engagement. Teachers should respond to students' questions carefully, provide feedback promptly, and in doing so, promote students' interest and initiative in the course and increase their engagement.

(3) From the perspective of the external environment, a positive and interactive environment can enhance students' self-motivation and desire for knowledge, effectively improving their learning engagement. At the same time, it also raises higher requirements for school management and platform developers. The stability of the online teaching platform directly affects students' learning experience. If the platform has many technical failures, malicious attacks, and other issues, it will cause students to develop negative emotions and attitudes, which will also affect their academic performance and

learning outcomes.[4]

In summary, the current blended learning model, which combines online and offline methods, has a significant impact on the learning engagement of Chinese university students, involving various aspects such as digital capabilities, interactive environment, platform stability, teacher-student interaction, and self-management. By strengthening the construction and improvement of these factors, students' learning engagement can be better promoted, and the quality of education and teaching can be optimized.

3.2. Analysis of the main causal relationship of students' learning engagement under the blended teaching model

(1) Student factors: University students' self-regulation, learning strategies, and cognitive abilities are important factors in their level of learning engagement. Self-regulation in students means they can control their emotions and behaviors, which helps them focus on learning tasks. Students' learning strategies include choosing appropriate learning methods and dealing with learning challenges. Students' learning strategies include choosing appropriate learning methods and dealing with learning challenges. Cognitive abilities involve the understanding and mastery of new knowledge and information. These factors have a positive impact on the learning engagement of university students in a blended learning model. As shown in Figure 1.

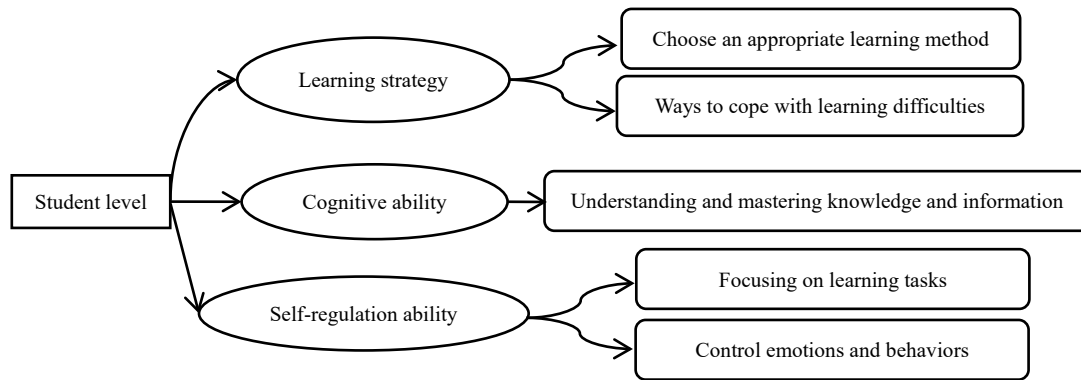


Figure 1: Analysis of Factors Affecting Student Engagement at the Student Level.

(2) Teacher aspects: In blended learning, teachers' instructional design and implementation play a vital role in students' learning engagement. Teachers should design and implement blended learning models based on students' needs and characteristics, providing timely feedback and guidance. Moreover, teachers should pay attention to students' emotional needs, establish good relationships, enhance motivation and interest, and thus promote students' learning engagement.

Roles of teachers in blended learning: Instructional Designer → Instructional Implementer

Tasks for teachers in blended learning are as follows. (a) Design and implement blended learning models according to students' needs and characteristics: Learning objectives → Learning differences → Learning styles; (b) Provide timely feedback and guidance: Diagnose students' learning problems → Offer solutions and suggestions → Assess students' learning outcomes; (c) Pay attention to students' emotional needs: Establish good relationships → Provide support and encouragement → Understand students' emotional states; (d) Enhance students' motivation and interest: Design challenging and attractive tasks → Engage students' participation enthusiasm → Consider students' interests and hobbies; (e) Promote student learning engagement: Create a positive learning atmosphere → Inspire students' learning passion → Cultivate students' learning self-discipline.

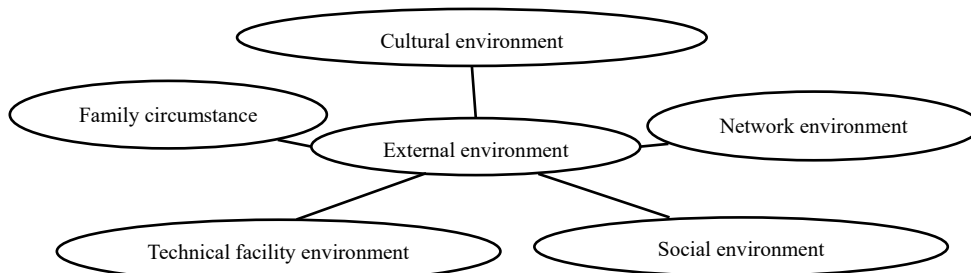


Figure 2: External Environment Factors Analysis on Learning Engagement.

(3) External environment aspects: The external environment includes factors such as family, society, and culture. A stable family environment, a strong cultural atmosphere, and positive social support positively affect university students' learning engagement. Additionally, the external environment also includes technological facilities and network environments. Convenient access to technological facilities and network resources has a positive impact on learning engagement. See Figure 2.

In summary, the main causal factors affecting university students' learning engagement in the blended learning model involve three dimensions: students, teachers, and external environment. Among these factors, students' self-regulation, learning strategies, and cognitive abilities, teachers' instructional design and implementation, as well as the stability and support of the external environment, all have a positive impact on students' learning engagement. [5]

4. Construction of an Analytical Model of Students' Learning Engagement under the Blended Learning Model

4.1. Model boundaries and assumptions

The purpose of this study is to determine the degree of influence of various factors on student learning engagement in blended learning mode and to propose improvement measures to enhance university students' learning engagement. Therefore, the following assumptions are made: (1) when studying student learning engagement in blended learning mode, only teachers, students, and external environment have significant impact, and other factors are not considered. (2) This article takes the learning engagement of Shanghai university students in the 2022-2023 academic year as an example and is not affected by the learning engagement measurement indicators of other regions or individual special teaching groups. (3) In the process of university students' learning activities, there are external interventions both online and offline, and students can communicate with each other, adjust some uncomfortable factors, and have the freedom to choose flexible teaching resources.

4.2. Data Analysis

4.2.1. Reliability analysis

Table 1: Table of questionnaire reliability analysis.

Cronbach's α ratio	Standardized cronbach's α coefficient	Number of terms	Sample number
0.684	0.685	3	318

The table below (Table 1) shows the results of the Cronbach's α coefficient for the model, including the Cronbach's α value, standardized Cronbach's α value, the number of items, and the sample size, which are used to measure the quality level of the data reliability. Based on the results, the reliability of the sample is between 0.6-0.7, indicating a fair to good level of reliability for the measurement data.

4.2.2. Descriptive statistics

Table 2 presents the results of descriptive statistical measures, including sample size, maximum value, minimum value, and other statistical measures, which are used to investigate the overall situation of quantitative data. The results show that the factors that have the greatest impact on learning are motivation and difficulty. In addition, classroom exercises and post-class learning are considered to have the greatest contribution to learning effectiveness. Learning engagement is influenced by both external environment and individual conditions, while learning methods and focus have a significant impact on individual learning engagement.

Table 2: Statistical analysis table of factors affecting learning effect.

Variable name	Sample capacity	Maximal value	Minimum value	Average value	Standard deviation	Median	Variance	Kurtosis	Skewness	Coefficient of variation (cv)
Which indicator currently has the greatest impact on your learning process	318	3	1	2.041	0.791	2	0.626	-1.398	-0.073	0.38770253820303235
What level was your average grade for the course last semester approximately	318	4	1	2.195	0.895	2	0.801	-0.43	0.483	0.40774029836857073
The contribution of the following four learning stages to learning effectiveness	318	10	0	6.208	2.684	7	7.206	-0.59	-0.505	0.43244122585142947
What aspects of a teacher do you think will affect your learning engagement	318	5	1	3.956	1.105	4	1.222	0.932	-1.224	0.27943930336944744
What aspects of the external environment do you think will affect your learning engagement	318	5	1	3.77	1.129	4	1.275	0.629	-1.1	0.29950156568386305
What aspects of yourself do you think will affect learning engagement	318	5	1	4.11	1.088	4	1.183	1.017	-1.315	0.26468120461592065

4.2.3. Differentiation analysis

Table 3: Results of the discrimination degree analysis.

	Group (mean ± standard deviation)			t	p
	0%-27% (n=86)	27%-73% (n=146)	73%-100% (n=86)		
In the current learning process, which indicator has the greatest impact on your learning?	1.779±0.773	1.993±0.766	2.384±0.738	-5.245	0.000***
In your opinion, among the four learning links, the contribution of each link to the learning effect is respectively	3.337±2.247	6.438±1.838	8.686±1.191	-19.505	0.000***
What aspects of your teachers do you think affect your learning engagement?	3.477±1.299	3.973±1.07	4.407±0.692	-5.86	0.000***
What aspects of self-immolation do you think will affect learning engagement	3.837±1.206	4.027±1.1.01	4.523±0.793	-4.407	0.000***

Note: ***, **, *Represents the significance levels of 1%, 5%, and 10%, respectively

Table 3 shows the results of the discrimination analysis. The P-value is significant at the level, and the null hypothesis is rejected, indicating that the design of scale items has high differentiation and reasonable design.

4.2.4. Analysis of key indicators

Table 4 shows the frequency of individual dimensions on learning effects.

Table 4: The frequency distribution table of the influence of individual dimension on learning effect.

Name	Option	Frequency	Percentage (%)	Cumulative percentage (%)
What aspects of yourself do you think affect learning engagement	5	145	45.597	45.597
	4	113	35.535	81.132
	2	26	8.176	89.308
	3	22	6.918	96.226
	1	12	3.774	100.000
Total		318	100.000	100.000

5. Strategies for Improving University Students' Learning Engagement under the Blended Teaching Mode

5.1. Promote better integration of online and offline teaching

Teachers should fully consider the differences and advantages and disadvantages of online and offline teaching in curriculum design and implementation, and appropriately integrate the two teaching modes through classroom guidance and interaction, so as to make the classroom more attractive and interactive. In specific teaching practices, teachers should fully understand the online environment (such as learning software) and offline environment (classrooms equipped with different facilities and optional teaching methods) they rely on for teaching practice, and incorporate factors that are suitable for the characteristics of the course and have student value recognition into the course. Skillfully reversing the phenomenon that some students prefer online courses because they believe they are easier, and creating online courses with greater comprehensiveness and higher classroom participation, better unifying online and offline assessment indicators, and making online teaching an effective extension and space expansion of offline teaching.

5.2. The teaching curriculum sets out a clear learning goal

Developing clear learning objectives can help students better understand the course content and learning tasks, and stimulate their interest and motivation in learning. When developing learning objectives, consideration should be given to course difficulty, student background, and practical applicability to ensure that the learning objectives are feasible and meaningful for students. Regarding course difficulty, for higher-level courses, multiple indicators should be tracked and implemented in modules and small stages, such as adding periodic online testing in offline classrooms for advanced mathematics, and providing detailed step-by-step solutions to students after submission. Concerning student background, considering students' economic status and learning habits, a multi-indicator course evaluation system that combines online and offline teaching methods should be adopted, and a reasonable score allocation should be made. Regarding practical applicability, it is especially important for humanities, history, finance, and economics courses to incorporate new content that is different from traditional education. This can be done by conducting planned practical operations in stages based on textbook content and collecting students' practical needs and feedback on participation effects in advance through online learning platforms.

5.3. Adopt diversified teaching strategies

Teaching is not only the job of teachers, but also a core part of the operation of various departments within the school. The widespread use of blended learning provides better opportunities for macro-level teaching in schools. Schools can develop corresponding curriculum standards and teaching plans to guide teachers to use various teaching methods and promote the practice of blended learning. At the same time, schools can provide necessary teaching support and resources, such as information technology equipment and teaching venues. Other stakeholders, such as parents and students, can actively cooperate with teachers and schools in teaching reform, create a good learning environment, and improve student learning outcomes as much as possible, so as to better adapt to the education and teaching of blended learning. Of course, teachers can also adopt diversified forms in this process. In terms of course content, teachers can choose different forms of teaching materials, including text, audio, video, etc. They can appropriately set courses based on students' learning habits and interests, stimulate students' learning interests and enthusiasm, and improve their learning outcomes. In terms of teaching methods, teachers can use various teaching methods, such as demonstration, storytelling, inquiry, discussion, case-based learning, etc., and choose appropriate teaching methods based on specific teaching content and students' learning status. This can better mobilize students' attention and imagination, and improve their participation. In terms of evaluation methods, diversified evaluation methods can help teachers better understand each student's learning status and encourage students' enthusiasm for learning. Evaluation methods can include individual assignments, group projects, final exams, etc. Innovative evaluation methods, such as oral presentations, discussions and debates, can also be used.

5.4. Provide timely feedback and guidance

In blended learning mode, students' daily use of online learning apps is becoming increasingly

frequent. Communication channels between teachers and students, as well as between the school and students, are more unimpeded. As a teacher, you can provide timely feedback on students' learning outcomes and performance, and provide appropriate guidance and assistance. Through timely feedback and guidance, you can help students better grasp the learning content, deepen their understanding and memory of knowledge, and thereby increase their learning engagement. As managers of various departments in the school, you can also carry out more refined remote supervision and more humane target setting through the use of online learning apps. This can promote timely feedback and guidance in various information transmission links of the education and teaching department and teachers

5.5. Strengthen students' independent learning ability

In a blended learning mode, students need to rely more on their own efforts and self-learning abilities to complete learning tasks. Therefore, teachers should fully respect students' personalities and needs in course design and implementation, encourage them to explore and learn independently, and cultivate their independent thinking and problem-solving abilities. For students themselves, they can develop their own learning plans on learning apps, set learning goals and schedules to help themselves better manage time and tasks. They can enhance their self-motivation and self-regulation abilities by adopting clear reward and punishment mechanisms, regularly checking their learning progress, and adjusting learning strategies in a timely manner to ensure learning effectiveness. They can also strengthen their mastery of learning resources, such as libraries, the Internet, and teaching videos, to broaden their knowledge and enhance their learning interests and enthusiasm. They can participate in online communication and collaborative learning with classmates and teachers through network platforms, solve learning problems, discuss course content together, and carry out cooperative learning activities. They should learn to self-assess and reflect, evaluate their own learning situation in a timely manner, and reflect and summarize in a timely manner, discover their shortcomings and make corresponding improvements. At the same time, they can also learn from successful cases, continuously improve their learning effectiveness.

6. Suggestions

6.1. The teacher level

Develop clear lesson plans and learning objectives to let students know what they are learning and how to learn; provide online learning resources and support, such as recorded lecture videos, online discussion forums and instant messaging tools, so that students can access what they need learning materials and communicating with them at anytime and anywhere; combining online and classroom teaching, using various methods and technologies to increase student engagement, such as teaching games, group discussions and case studies; giving timely feedback to students, including evaluating student assignments and tests, and give advice and guidance.

6.2. The student level

In order to improve students' learning interest and motivation, it is important to connect learning content with real-life situations and encourage students to engage in self-directed learning and exploration. Enhancing students' learning abilities and skills, such as providing training in time management, learning strategies, and information retrieval techniques, is also essential. Encouraging students to participate in classroom and online discussions and actively collaborate and communicate with other students will foster a better learning environment. Additionally, assisting students in setting clear learning goals and plans, tracking their progress and making timely adjustments can further support their academic development.

6.3. External environment level

It is important to provide good learning resources and facilities such as libraries, laboratories, and e-books; strengthen educational technology infrastructure and support such as internet access, security protection, and technical training; promote student participation and interaction, for example by organizing online and offline exchange activities, cultural and sports events; and provide appropriate support and services to students, such as psychological counseling, career guidance, and financial assistance.

7. Conclusion

In a blended learning model, teachers need to understand the differences and advantages and disadvantages of online and offline teaching modes, integrate both modes and set clear learning objectives to improve student learning outcomes and adapt to the blended teaching model. In addition, it is recommended that schools establish curriculum standards and teaching plans to provide guidance and support for teachers. Students should actively cooperate with teaching reform efforts and teachers should adopt diverse approaches to improve learning outcomes in terms of content, methods, and evaluation. Timely feedback and guidance can help students better grasp learning content and enhance their engagement in learning. Students should improve their self-directed learning abilities, cultivate independent thinking and problem-solving skills and master learning resources and autonomous communication, collaboration, evaluation, and reflection. Finally, school management departments can promote the implementation of blended learning through more refined remote supervision and indicator settings, facilitating information transmission and timely feedback.

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