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University Students' Learning Behaviors and Influential Factors under the Blended Teaching Mode

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Abstract: The advancement of educational informatization has driven the continuous upgrading of teaching modes in universities. Blended teaching mode, which integrates the strengths of both online and offline teaching, has received extensive attention in the past decade. This study reviews literature relating to factors influencing student learning behaviors within a blended teaching environment according to social cognitive theory, self-determination theory, and planned behavior theory, aiming to systematically categorizing the key factors affecting student learning behaviors. The findings indicate that students' learning behaviors in blended teaching contexts are influenced by three groups of factors: environmental factors (i.e., organizational effectiveness, learning resources, and learning support services), personal factors (i.e., self-efficacy, learning motivation, willingness to learn), and interactive factors (system integration, teaching feedback, group cooperation). This study contributes to theoretical advancements in blended learning pedagogy and offers practical strategies for optimizing instructional design, enhancing instructor-student engagement, and improving technological integration in blended teaching contexts.

Keywords: Students' Learning Behaviors; Influential Factors of Learning Behaviors; Blended Teaching Mode.

1. Introduction

The rapid development of Internet technology and the informatization of education has promoted the ongoing transformation of the "Internet + education" paradigm on a global scale. Over the past decade, the development of online courses has become a focus in the curricular construction of Chinese universities, and the blended teaching mode has emerged accordingly. This trend was further accelerated by the unforeseen outbreak of the COVID-19 pandemic, which necessitated the transition of university classrooms to fully or partially online formats [1]. The blended teaching mode, which combines the strengths of both online and offline teaching by integrating the instructional role of instructors with the active engagement of students, is particularly well-suited to meet the needs of university students for autonomous and personalized learning. Consequently, it has become a focal point of classroom teaching practice in universities in recent years. Despite its progress, the implementation of blended teaching continues to encounter several challenges, for example, "technological hollowing out" due to instructors' insufficient digital literacy, cognitive overload from students' multitasking, impact of the urban-rural digital divide on educational equity, etc. [2].

These challenges not only pose difficulties for instructors to guarantee their teaching quality, but also highlight the urgent need for blended teaching to evolve from mere technology integration to a student-centered approach. Addressing these issues is essential to achieve effective educational outcomes and render teaching reforms more impactful. Research on blended teaching to a great extent focuses on factors influencing student learning behavior. Existing studies examine various determinants of student learning behaviors, such as motivation and self-efficacy, yet a comprehensive review of these influencing factors is lacking. In this regard, this paper reviews the literature and synthesizes factors affecting student learning behaviors within the blended teaching mode, aiming to offer recommendations for optimizing blended teaching design and enhancing student learning outcomes.

2. Blended Teaching Mode

The blended teaching mode represents an innovative educational paradigm that combines the strengths of online and offline instruction [2]. Its core objective is to realize a multi-dimensional integration of teaching and learning methods through technological empowerment. This mode not only preserves the deep interaction and emotional connections characteristics of traditional classrooms but also extends the temporal and spatial boundaries of learning, offering personalized learning pathways through digital tools. Grounded in constructivist learning theory, it underscores the importance of students actively constructing knowledge through exploration and collaboration, rather than passively receiving information [3].

The evolution of the blended teaching mode can be delineated into three distinct stages [4]. From 2000 to 2010, the focus of the blended teaching mode was on technology integration, characterized by the unidirectional transmission of online resources. Between 2011 and 2019, the emphasis shifted towards student-centered personalized learning design, highlighting the integration of online and offline activities. Since 2020, the blended teaching mode has increasingly incorporated intelligence and adaptability, primarily through the integration of technologies such as artificial intelligence and big data analysis.

Over more than two decades of practice, three styles of blended teaching have emerged. The first style is the complementary type, which combines online knowledge instruction with offline practical application, exemplified by case-based teaching [5]. The second style is the flipped classroom, which utilizes MOOC-based (Massive Open Online Course-based) pre-class preparation and in-class discussions to enhance understanding, as seen in the Small

Private Online Course (SPOC) model [6]. The third style is cooperative teaching, which fosters collaborative skills through the integration of resources across institutions and localized tutoring [7]. From the perspective of teaching outcomes, blended teaching has been shown to improve student learning effectiveness by reducing the variability in student grades. It also enhances students' autonomous learning abilities, as online learning platforms allow students to control their learning pace and resource selection, while classroom discussions promote their critical thinking. Furthermore, the blended teaching mode optimizes educational resource allocation. By disseminating high-quality courses across various universities, the disparity in educational levels between regions has been reduced.

3. Factors Influencing Students' Learning Behaviors

Through a review of literature, factors influencing students' learning behaviors are categorized into three groups (figure 1). The first group comprises environmental factors, which include

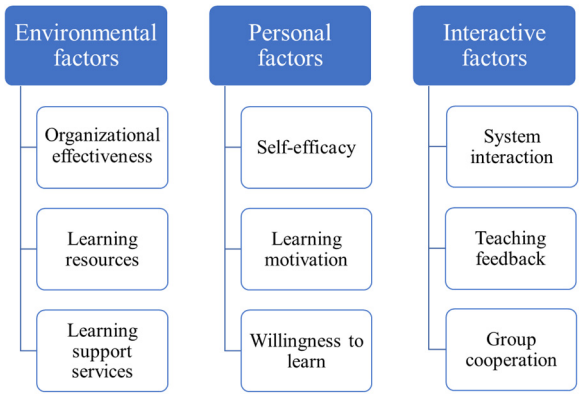

Fig 1. Influential factors of university students' learning behaviors under the blended teaching mode

organizational effectiveness, learning resources, and learning support services. The second group consists of personal factors, such as self-efficacy, learning motivation, and willingness to learn. The third group involves interacting factors, including system integration, instructor feedback, and peer cooperation.

3.1. Environmental Factors

3.1.1. Organizational effectiveness

Organizational effectiveness is defined by the systematic design of curricula, the standardization of teaching management, and the rationality of evaluation mechanisms [8]. Research indicates that the organizational effectiveness of blended teaching necessitates the dynamic adaptation of teaching goals through the collaborative design of online-offline activities. Specifically, the curriculum structure must be designed to balance the emphasis on autonomous learning and instructor guidance [9]. If instructors fail to appropriately assign weights to evaluation indicators for online autonomous learning—such as relying solely on video viewing duration—it may result in students engaging in concentrated efforts to improve their scores at the end of the term, thereby diminishing the overall quality of learning. Moreover, teaching management must prioritize effective time allocation and seamless task integration. Empirical research has demonstrated that offline classroom interactions, such as group discussions facilitated by project-based learning methods, have a significant positive correlation with final grades [10]. This suggests that instructors should foster knowledge internalization through well-structured task design. Additionally, the scientific evaluation mechanism has a direct impact on student participation. For instance, feedback evaluation plays a crucial role in enhancing learning engagement, including instructor-student interaction and group collaboration, and should be emphasized in assessments.

3.1.2. Learning resources

The influence of learning resources on students' learning behaviors is evident in the quality, accessibility, and adaptability of these resources. The diversity, cutting-edge nature, and adaptability of learning resources are fundamental factors influencing students' learning behaviors in a blended teaching environment. Firstly, blended teaching must incorporate a diverse array of resources, including text, video, and virtual simulations, to address varied learning needs [11]. Research indicates that students' knowledge absorption is enhanced when they engage in multi-sensory learning through multimedia resources, such as online videos and courseware. Consequently, the deployment of multiple resources necessitates a structured design. Fragmented resources may result in information overload, whereas a hierarchical and progressive SPOC resource package can optimize the learning path. Secondly, the dynamic updating of resources is vital for sustaining student motivation [12]. The continual updating of the resource library within the blended learning mode, including the addition of new industry case studies and interdisciplinary materials, can stimulate students' interest in exploration. Thirdly, the compatibility between learning resources and teaching objectives significantly influences students' learning behaviors [13]. Empirical studies demonstrate that online assessments featuring immediate feedback, such as adaptive question banks, can enhance the reinforcement of knowledge, whereas static resources are more likely to lead to learning fatigue.

3.1.3. Learning Support Services

Learning support services are crucial for maintaining the continuity and depth of students' learning in a blended teaching environment. These services encompass technical support, instructor feedback, and peer collaboration. Firstly, the stability of the technical infrastructure is essential for effective blended teaching [14]. Issues such as network latency and platform compatibility can lead to technical anxiety among students, thereby diminishing their online engagement. Secondly, timely and personalized feedback from instructors on student performance is imperative [15]. The impact of feedback evaluation on learning engagement is second only to the design of organized teaching. However, due to time constraints, instructors often resort to providing standardized feedback. Integrating dynamic feedback with learning analytics, such as weekly learning reports, can enhance the specificity and relevance of the feedback. Additionally, emotional support from instructors is vital, as it can significantly alleviate students' technical anxiety through encouraging communication in online communities. Thirdly, peer collaboration, including teamwork efficacy and peer support, is integral to student learning behavior and is contingent upon the design of effective collaboration mechanisms [16]. For instance, cross-disciplinary collaborative projects have the potential to broaden students'

social networks and facilitate the exchange of knowledge. Nonetheless, an unequal distribution of group tasks can result in the "free-rider" phenomenon. To address this issue and ensure fairness, it is essential to implement contribution quantification tools, such as collaborative log analysis.

3.2. Individual Factors

3.2.1. Self-efficacy

Self-efficacy pertains to students' beliefs in their capacity to accomplish specific learning tasks. According to social cognitive theory, self-efficacy is shaped by four types of experiences: direct experiences, such as successes or failures in online assessments; vicarious experiences, such as observing peers' successful outcomes; verbal persuasion, such as feedback from instructors; and emotional arousal, such as anxiety related to technology [17]. In a blended learning environment, students' self-efficacy can be significantly influenced by hierarchical task design, peer collaboration, and immediate feedback mechanisms. For example, hierarchical task design enables students to build successful experiences through incremental learning objectives. However, blended learning may also intensify disparities in self-efficacy. The digital divide between urban and rural areas results in a reduced utilization rate of online resources among rural students [18]. Additionally, the cognitive overload induced by technological complexity further diminishes their confidence.

3.2.2. Learning motivation

Student learning motivation can be categorized into intrinsic motivation, such as interest-driven factors, and extrinsic motivation, such as academic performance [19]. According to self-determination theory, the quality of motivation is contingent upon the degree of satisfaction of autonomy, competence, and sense of belonging [20]. In the context of blended teaching, the stimulation of motivation depends on balancing three sets of contradictions: autonomy versus structuring, competition versus cooperation, and immediate rewards versus delayed feedback . The openness of online resources grants students the freedom to choose; however, the absence of guidance often results in students merely striving to earn credits [21]. Consequently, it is imperative to establish clear learning goals and dynamic path recommendation systems to enhance student engagement in autonomous learning. Regarding the balance between competition and cooperation mechanisms, research has demonstrated that gamification elements, such as ranking lists, can effectively stimulate student extrinsic motivation; however, excessive competition may diminish intrinsic interest [22]. In terms of immediate rewards and delayed feedback, research has demonstrated that immediate scoring of online assessments enhances short-term motivation, while the presentation of outcomes from project-based learning fosters a long-term professional identity [23].

3.2.3. Willingness to learn

Students' willingness to learn, as an indicator of their prior commitment to blended learning behaviors, is influenced by their attitudes, subjective norms, and perceived behavioral control, as outlined in the theory of planned behavior [24]. In a blended learning environment, the development of willingness to learn exhibits polarized characteristics [25]. Specifically, students with high intent are inclined to set mastery-oriented goals, such as deep learning, and their actions are driven by intrinsic cognitive needs. On the contrary, students with low academic intent often prioritize performance goals, such as earning credits, which is reflected in behaviors like signing in and clocking in while avoiding deeper engagement. These students are at a comparatively higher risk of dropping out.

3.3. Interactive Factors

3.3.1. System Interaction

System interaction primarily concerns the functionality of the technical platform, the user-friendliness of the interface design, and the adaptability of intelligent algorithms. Research indicates that system interaction in blended learning environments should facilitate the dynamic optimization of the learning process through a "human-machine collaboration" mechanism [26]. For instance, interface design should minimize information overload and enhance operational fluidity. Moreover, hierarchical navigation menus and visual focus guidance techniques can substantially reduce students' cognitive load, thereby improving task completion efficiency [27]. AI-driven personalized recommendation systems can also enhance learning efficiency, with particularly significant effects observed in STEM courses [28].

3.3.2. Teaching Feedback

Rapid and personalized teaching feedback are critical determinants of interaction quality in blended learning. The immediate feedback mechanism is operationalized through automated scoring systems and learning analytics tools. For example, the implementation of automatic code error correction functionalities in programming courses can significantly reduce the time required for error rectification [29]. To achieve targeted educational outcomes, it is essential to integrate personalized feedback with the analysis of individual students' learning behavior data. Emotional feedback, exemplified by instructors' encouraging remarks in online discussion forums, has been shown to alleviate students' anxiety and enhance their engagement in discussions [30]. Conversely, delayed instructional feedback tends to diminish students' motivation to participate.

3.3.3. Group Cooperation

Group cooperation represents a fundamental interactive component in the knowledge construction process within blended learning environments. Its effectiveness is influenced by both the division of roles and provision of technical support [31]. For example, employing heterogeneous grouping strategies can enhance collaborative diversity by incorporating varied learning styles, technical skills, and cultural backgrounds. The innovative outputs generated by heterogeneous groups are notably superior to those of homogeneous groups. Nonetheless, it is crucial to implement conflict mediation mechanisms, such as online negotiation tools, to prevent the polarization of opinions [32].

4. Discussion

The implementation of blended teaching mode has exposed several contradictions among technological application, instructional design, and student adaptability. The technological divide is evident in the unequal distribution of educational resources between urban and rural regions. Disparities in hardware capabilities hinder some students' ability to fully engage in online interactions, such as the limited utilization of virtual reality resources [18]. To mitigate the digital divide, it is essential to adopt lightweight technology designs and implement supportive policies. The inconsistency in instructional design is reflected in the

disconnect between online and offline activities. Some instructors, lacking proficiency in blended teaching, have made courses becoming superficial, with students frequently focusing on improving their scores at the end of the term. Closed-loop instructional design, such as dynamic task allocation, has been shown to enhance teaching coherence [33]. However, instructors need to transition from being mere "knowledge transmitters" to "learning facilitators" and provide dynamic support throughout the learning process. The variations in student adaptability are evidenced by a notable increase in the dropout risk among students with low motivation, primarily attributed to the misalignment of learning objectives and inadequate self-regulation skills. Addressing this issue necessitates a dual approach that combines metacognitive training with blockchain-enabled smart contracts, thereby converting learning commitments into verifiable "learning oaths" [34]. Concurrently, it is essential to reformulate student behavioral norms through the establishment of a supportive learning community.

To improve the quality of blended learning in social science courses such as tourism, three recommendations are proposed. Firstly, the application of virtual reality technology is suggested to simulate immersive tourism scenarios, such as virtual reconstructions of heritage sites and AI-powered cultural experience platforms [35]. This approach aligns with the "tourism + culture" innovation model, allowing students to explore otherwise inaccessible environments, such as historical landmarks or rural tourism projects, through 3D modeling and interactive simulations. Secondly, it is recommended to develop structured online discussion frameworks utilizing asynchronous forums and role-playing activities to promote critical thinking. Implementing scaffolded discussion models can guide learners in analyzing tourism marketing cases or ethical dilemmas in cultural resource management [36]. This should be augmented with AI-driven feedback systems to personalize learning paths based on metrics of discussion participation. Thirdly, the combination of field investigations with digital marketing projects is advised, such as designing virtual tourism routes or creating data-driven destination branding campaigns. For example, students could collaborate with rural "new farmers" entrepreneurs to develop creative tourism products while utilizing digital platforms.

This research contributes to the academic discourse in several key areas. Firstly, it reviews social cognitive theory, self-determination theory, and planned behavior theory to identify the diverse factors influencing student learning behaviors within a blended learning environment, thereby elucidating the synergistic interactions among environmental, individual, and integrative factors. Secondly, the study categorizes the determinants of student learning behaviors and examines the critical factors within each category, offering a framework for assessing student learning outcomes in future educational evaluations.

5. Summary

The hierarchical implementation strategy for blended teaching should prioritize individual student differences as its core focus, integrating technological empowerment and dynamic adjustment of teaching design. The collaborative application of heterogeneous and homogeneous grouping is essential for enhancing hierarchical efficiency. In offline teaching environments, heterogeneous grouping can facilitate cross-capability collaboration, whereas homogeneous grouping can be employed in online settings to enable precise resource allocation, such as forming same-level learning groups across different classes. Curriculum design should adhere to the principle of balancing challenge and support. For instance, in science, technology, engineering, and mathematics courses, hierarchical navigation menus should be utilized to reduce cognitive load, while providing advanced learners with extended resources such as virtual laboratories. Furthermore, a dynamic stratification mechanism should be integrated throughout the entire teaching cycle. By analyzing learning behavior data, including online test accuracy rates and resource access frequency, student levels can be dynamically adjusted to prevent the negative effects of label solidification on learning motivation. From a technical perspective, lightweight platforms can mitigate the performance disparities between urban and rural equipment. Additionally, the use of blockchain technology's support matrix can enhance transparency in group collaboration and reduce the occurrence of the "free-rider" phenomenon. Future research should focus on exploring the virtual hierarchical space enabled by the metaverse to facilitate seamless transitions between cross-regional collaboration and personalized learning environments.

The sustainable development of blended teaching is contingent upon a comprehensive policy support system. Resource and funding allocation policies should prioritize rural and underdeveloped areas. Dedicated funding should be allocated to support the research and development of lightweight technologies, such as VR teaching modules that adapt to low bandwidth, and to promote the dissemination of necessary hardware. The policy on instructor capacity building should develop a comprehensive training framework encompassing technical literacy, instructional design, and cross-cultural communication. This framework should integrate effective teaching methods into the instructor certification system and enhance the capacity for hierarchical task design. Additionally, reforming the evaluation system necessitates moving beyond the constraints of traditional standardized tests by incorporating learning and analytical data, such as the semantic features of online discussions, collaboration logs, and emotional computing feedback, including facial expression monitoring. Furthermore, a cross-departmental collaboration mechanism should facilitate deeper cooperation between educational institutions, enterprises, and technology providers, foster the development of educational resource libraries, and ensure the timeliness and adaptability of resource updates. Policy-making must also remain vigilant against technical ethical risks by establishing decentralized learning data storage standards, implementing algorithm transparency review systems, and balancing personalized services with privacy protection.

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