A Review of the Relationship between College Students' Learning Engagement, Learning Environment, and Learning Outcomes

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Abstract: China's higher education system has achieved a historic leap, marking a stage of wider accessibility and popularization. With the rapid development of higher education, concerns are arising regarding the decline in its quality. As the main stakeholders in higher education, college students are a direct reflection of higher education quality. However, current assessments of higher education quality often overlook crucial aspects such as students' learning experiences, learning engagement, learning environment, and learning outcomes, which are important variables in understanding college students' learning processes. Through literature review, it has been found that previous studies have mostly focused on a single variable, exploring the antecedent or outcome variables separately, and rarely combining learning environment, learning engagement, and learning outcomes, nor reflecting the causal development relationship among the three. This paper addresses this gap by providing an overview of the collective landscape and interrelationships among these three learning variables. It also seeks to offer insights for enhancing undergraduate quality assessment in universities and promoting the overall quality of higher education.

Keywords: College students; Learning engagement; Learning environment; Learning outcomes;

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INTRODUCTION

Learning engagement, learning environment, and learning outcomes are the most important indicators for studying the learning situation of college students. As the main participants in higher education activities, college students are the most direct reflection of the quality of higher education. In recent decades, “quality” has been one of the most popular keywords in higher education, and it is common these days that tertiary educational institutions are required to provide evidence that students benefit from their experience in universities. For example, college students from countries such as the United States, the United Kindom, and Australia must participate in national student surveys to collect information on their learning engagement, learning outcomes, and other factors to evaluate their learning experience and educational quality.

In China, the development of higher education is considered a top priority. The report of the 20th National Congress of the Communist Party of China proposed the “Implementation of the Strategy of Revitalizing the Country through Science and Education,” emphasizing the important role of education in the comprehensive construction of a socialist modernized country. Higher education is the bridge between science and technology, as well as talent and innovation. To achieve the Chinese path to modernization, priority is given to building a strong country in higher education and promoting the high-quality development of higher education.

The evaluation of educational quality has also been a popular topic in China's higher education research in recent years. From 1980 to 2020, the scale of global higher education rapidly expanded, with the world's higher education population increasing from 50 million to 240 million. As of 2022, data released by the Ministry of Education shows that the population receiving higher education in China has

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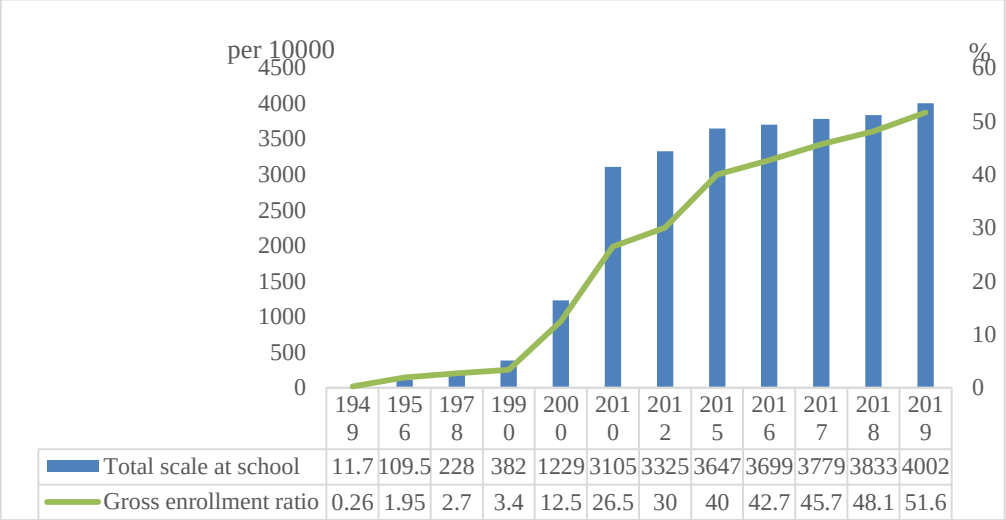
reached 240 million, and the number of graduates from ordinary universities in China in 2023 has reached 11.58 million. China's higher education has achieved a historic leap and entered the universally recognized stage of popularization. Since implementing the policy of expanding enrollment in universities in 1999, China's education scale has grown significantly, and higher education has developed rapidly. In 2010, the total enrollment of higher education reached 31.05 million people. Afterward, the growth rate of scale slowed down. In 2019, the total number of students enrolled reached 40.02 million, and the gross enrollment rate exceeded 50%, reaching 51.6%. Higher education officially entered the stage of popularization.



	1949	1956	1978	1990	2000	2010	2012	2015	2016	2017	2018	2019
Total scale at school	11.7	109.5	228	382	1229	3105	3325	3647	3699	3779	3833	4002
Gross enrollment ratio	0.26	1.95	2.7	3.4	12.5	26.5	30	40	42.7	45.7	48.1	51.6

The Development and Changes of the Total Scale at School and Gross Enrollment Ratio of Higher Education in China

However, the rapid development of higher education has caused problems, especially the decline in the quality of higher education teaching. Therefore, the country has shifted the focus of higher education construction from pursuing scale-up development to higher-quality development. Within the context of attaching importance to the quality of higher education, teaching quality is now increasingly considered the core of higher education (Guo et al.,2017). China has established a relatively complete higher education quality evaluation system, with multiple entities participating, including universities, government, and society. However, there are still problems, such as a lack of quality culture, a lack of normative standards for social evaluation, a lack of motivation for universities to conduct internal evaluations, and unclear power and responsibility relationships among third-party evaluation entities (Song, 2020). Among them, the internal evaluation of universities almost ignores the evaluation of students, such as their learning experience. Some scholars have proposed an evaluation perspective focusing on student development. For example, Jones (2014) proposed that higher education must focus on students' learning situation, as one of the core goals of universities is to ensure the quality of learning for college students. The benefits of students in the learning process can be seen as a symbol of improving the quality of education in schools, and it is also a key focus of education quality evaluation.

Surveys on the effectiveness of education on students have been widely used in many countries to evaluate teaching quality and learning experiences (Marsh, Ginns, Morin, & Nagengast, 2011). A large amount of research has emerged in student evaluation and teaching evaluation, becoming one of the most widely studied topics in higher education. Scholars in China have conducted national or local surveys on college students' learning engagement, investigating their learning motivation, behavior, and psychology (Wang, 2016; Li, Guo & Lv, 2022). Although research on student evaluation of teaching quality is still in its early stages, this topic is gradually receiving attention in higher education in China.

LITERATURE REVIEW PROCEDURES

Many researchers have independently studied learning engagement and learning environments from multiple perspectives. However, few studies investigate the combined impact of these two independent variables on learning. This study attempts to bridge the gap by integrating the two variables of learning engagement and learning environment, exploring the relationship between learning outcomes through a literature review, and help universities understand the learning problems of college students,

improve education models, optimize the learning environment, increase their learning engagement, thereby improving undergraduate education and teaching and ultimately enhancing the quality of higher education.

LEARNING ENGAGEMENT

The concept of learning engagement

The concept of learning engagement was first proposed in the 20th century and has two core characteristics: firstly, the amount of time and effort students put into learning and other activities; Secondly, how schools allocate resources, organize courses, and provide other learning opportunities and services to deepen students' participation in learning and promote ideal educational outcomes. Connell and Wellborn (1991) proposed that learning engagement refers to the level and intensity of students' emotional engagement when starting and engaging in learning activities. Shaufeli et al. (2002) pointed out that learning engagement refers to the attitude of students showing enthusiasm for learning and being in a continuous state during learning. Its main characteristics are highly focused attention, vitality, and dedication, reflecting a high level of energy and a strong sense of identity in learning, with energy focused but not scattered. Another study suggests that learning engagement refers to the amount of energy and time an individual invests in effective educational activities both academically and in the classroom, as well as how schools can attract students in specific practices, systems, and policies to promote their learning (Wang, 2011). Similar studies have shown that learning engagement is a positive and complete emotional and cognitive state related to learning activities, with persistence and dispersion characteristics manifested as students dedicating their time and energy to learning activities or fully participating in learning activities (He & Chen, 2008). Therefore, learning engagement is a fundamental component of understanding academic performance, a potential meta-structure in education, reflecting a person's participation in tasks or activities, the level of emotional experience, and the specific intensity of behavior when students begin and implement learning activities.

Learning engagement theory and its indicator system

Learning Engagement Theoretical Education Practice Benchmark from 2000 to 2012	**Theoretical Indicator System for Learning Engagement after 2013**	
	Theme	**Challenge**
Level of Academic Challenge	Academic Challenge	High-Order Learning
		Reflective & Integrated Learning
		Learning Strategies
		Quantitative Reasoning
Active and Collaborative Learning	Learning with Peers	Collaborative Learning
		Diversified Communication
Student - Faculty Interaction	Experience with Faculty	Student Faculty Interaction
		Effective Teaching Practices
		Quality of Interactions
Enriching Educational Experience	Campus Environment	Supportive Environment
Supportive Campus Environment		

Based on the research of past scholars, Kuh (2001) proposed the theory of learning engagement, which refers to the time and energy spent by students on effective learning activities, as well as how students approach the support provided by the school. Firstly, learning engagement has important value and significance for the learning effectiveness and quality of college students' university education. The effective learning time and level of energy investment of college students are the only best indicators to predict their academic and developmental status (Kuh, 2001). Compared to similar types of universities, those that attract students and encourage them to participate more in activities have high-quality education and teaching. In other words, the main factor in university education is the degree to which students engage in learning. Secondly, the theory of learning engagement emphasizes the important role of effective support from schools in students' learning outcomes. Schools provide students with an ideal campus environment and high-quality educational resources, attracting them to invest time and energy in learning activities, thereby improving their academic achievement and development. Kuh (2001) regards

teacher-student interaction and peer interaction as the main aspects of student behavior, believing that teacher-student interaction and peer interaction are the main factors affecting students' academic performance. Therefore, only when better cooperation is achieved between students and teachers and between students and students can the quality of undergraduate education and teaching be guaranteed.

Kuh (2006) proposed that learning engagement is the intersection of student behavior and institutional behavior, which is the core concept of this theory. Kuh organized the National Survey of Student Engagement (NSSE) development based on their understanding of learning engagement. From 2000 to 2012, NSSE proposed five benchmarks for learning engagement. After 2013, the NSSE team made significant revisions to the indicator system, revising the original five benchmarks to 10 learning engagement indicators (McCormick et al., 2013).

Dimensions of learning engagement

Many scholars generally believe that learning engagement is a multidimensional structure (Fredricks, 2004), at least composed of behavioral and emotional components (Christenson et al., 2012). Some scholars have added the dimension of cognitive engagement or divided behavioral engagement into two subcategories: academic engagement and behavioral engagement (Appleton et al., 2006). Both Finn (1989) and Marks (2000) think learning engagement consists of behavioral and emotional dimensions. Specifically, behavioral engagement means students' involvement in the classroom and other activities; Emotional engagement means varying degrees of identification, belonging, and learning values towards the school. Finn (1993) also emphasizes the significance of emotional engagement in terms of whether students feel emotional belonging to the school environment and in evaluating school-related outcomes such as truancy and dropout. Skinner (1993) analyzes both positive and negative aspects of learning engagement, namely learning engagement and learning dissatisfaction, including two dimensions of behavior and emotion. Specifically, positive behavioral engagement refers to students exhibiting sustained behavior, effort, and concentration in learning activities, while on the contrary, it is passive, effortless, and easy to give up. Positive emotional engagement refers to human emotions, optimism, curiosity, and interest, while the opposite is boredom, fatigue, depression, and pain (Skinner, 1993). In addition to behavioral and emotional engagement, scholars such as Appleton (2008) define learning engagement as students' psychological and behavioral engagement.

Fredricks et al. (2004) divided learning engagement into behavioral, cognitive, and emotional. Behavioral engagement includes positive behavior (such as adhering to school rules), participating in learning tasks (such as focusing on participating in classroom discussions), and joining the school's activities. Emotional engagement means students' feelings and values in the classroom. Cognitive engagement includes psychological engagement, problem-solving cognitive strategies, and self-regulation in learning during the learning process.

Reeve et al. (2011) proposed agency engagement as the fourth dimension of learning engagement for the first time, based on their recognition of Fredricks' three dimensions. Agency investment refers to the positive contributions made by students in the teaching, taking observable events in the classroom as examples, such as providing opinions, raising questions, etc. (Reeve, 2011). Subsequently, Reeve (2013) once again structured the definition of agency investment, including students asking questions and expressing their preferences and suggestions to teachers. According to him, the concept of three dimensions reflects the varying degrees of students' reactions to teachers' release of learning activities. Still, it ignores the active contributions made by students in the learning process, not just passively accepting the learning activities provided by teachers (Reeve, 2012).

In summary, within the multidimensional conceptual framework, there is a cross-overlap between the various dimensions of learning engagement, which is dynamically interconnected. Many scholars have reached a consensus on these dimensions in their research. However, as research deepens and new dimensions continue to expand, further practice is needed in empirical research to continuously explore the characteristics of each dimension to characterize a richer state of learning engagement.

Assessment of learning engagement

The student self-report method is a commonly used method for measuring learning engagement, which requires students to report the quality of their behavioral, cognitive, and emotional engagement levels through questionnaires or scales and can predict which students may face academic risks or which students may benefit from them (Fredricks, 2019). Skinner et al. (2009), based on the Rochester Assessment Package for Schools (RAPS), developed a behavioral input questionnaire from two dimensions of effort and attention (Skinner et al., 2009). Gunuc et al. (2015) also focus on students' behavioral engagement, which includes active and passive participation. The questionnaire covers dimensions such as participation, attention, persistence, interaction, and compliance. The Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pinrich et al. (1991) has been used as a reference standard for measuring cognitive engagement by many researchers, with the self-regulation

subscale in cognitive strategies and metacognition being more typical. Watson et al. (1988) compiled ten projects from positive and negative dimensions, with most of the data collected from college students achieving satisfactory results.

Research has shown that qualitative measurement is the second most common method for measuring learning engagement (Greene, 2015), with textual data being the focus of researchers who use different coding standards or frameworks as the basis for analysis. Researchers such as Lin et al. (2012) used content analysis methods to explore the metadata qualitatively attached to bookmarks (such as annotations and comments). Cluster analysis results showed that learners' levels of cognitive engagement can be divided into “deep” and “surface.” Li Yanyan et al. (2020) adapted Zhu's cognitive engagement coding table and analyzed the content of group discussion posts, ultimately measuring the level of group cognitive engagement. Oh et al. (2016) analyzed the thinking skills level of participants in debates by collecting recorded debate content and using Bloom's cognitive learning classification as the coding standard.

Physiological measurement methods are currently being applied in education. By collecting and processing data on students' behavior and internal psychological state during the learning process through physiological devices, students can measure different behavioral, cognitive, or emotional engagement levels, such as concentration and emotional state. For example, Wang Cuiru et al. (2021) believe that eye movement and EEG data can objectively explore learners' learning engagement levels. Li Xin et al. (2021) monitored the change in learners' heart rate levels through heart rate bands and collected heart rate data to represent learners' emotional engagement. At the same time, they used facial expressions collected by cameras and dialogue interview data recorded by tape recorders to represent the change process of learners' emotional engagement in multiple dimensions.

In summary, many measurement methods for learning engagement mainly rely on a single measurement method, directly conducting quantitative or qualitative research on students' behavior, cognition, and emotional engagement levels. There are few mixed studies of multiple measurement methods, which are mainly based on non-real-time measurement, and there is also a relatively small use of learning achievement as an indirect standard for measuring learning engagement levels (Henrie et al., 2015). In addition, measuring students' learning engagement with physiological sensors has become an important direction for the future development of learning engagement assessment.

Factors influencing learning engagement

Most studies show that individual factors of learners can affect learning engagement. Wan et al. (2021) conducted a survey on the online learning engagement level among 4841 college students. They found that gender, grade, and learning duration directly affect the online learning engagement level among relevant groups. Li and Yu (2015) conducted a questionnaire-sampling survey on 443 remote students, and the study showed that differences in gender, occupation, marriage, and family background among students may lead to differences in learning engagement. In addition, an individual's non-cognitive abilities can affect learning engagement. Lan Guoshuai et al. (2019) conducted an online questionnaire on 329 students and found that learners' academic self-efficacy, teaching presence, and perceived usefulness positively impact their learning engagement. Students' interest in learning can also affect learning engagement. He and Chen Xiangming interviewed three college students and found that when there is a lack of interest in learning, external pressure is often an important factor affecting learning engagement.

Family is another factor that affects learners' learning engagement. Zhou and Zhang (2018) conducted a survey on 355 students and found that parent-child communication had a significant impact on their learning engagement. The higher the parents' educational expectations, the greater the positive effect on learning engagement. Zhao Min et al. (2018) surveyed 255 students through interviews and questionnaires. They found that parent-child relationships, parental educational expectations, and educational methods have a positive effect on the learning engagement of migrant children. In addition, students from high-social-status families will invest more in learning, and learning self-efficacy can play a significant role during this period (Shi Leishan, 2013); The cultural level of parents is conducive to increasing the college students' learning engagement (Wang & Liu, 2016).

School factors can also affect students' learning engagement. Liu Zaihua (2018) conducted a study on 1411 migrant children through a questionnaire survey and found a significant correlation between school atmosphere and learning engagement among migrant children. Regarding teacher support, Huang et al. (2018) used a questionnaire survey method to analyze data from 185 in-service teachers. They found that learners' perceived social, teaching, and cognitive presence significantly correlated with their emotional, behavioral, and cognitive engagement, respectively. The impact varied from strong to weak, indicating that teacher support can effectively improve learners' learning engagement.

Regarding the learning environment, Shi et al. (2021) used quantitative research to investigate 385 high school students. They showed that a mixed synchronous learning environment positively impacts students' internal and external motivation. This conclusion is consistent with Kirschner et al. (2004), stating that the lack of teaching availability, social interaction availability, and technical support

availability in a learning environment can lead to disappointment among teachers and students, reduce their learning motivation, and ultimately lead to negative learning outcomes.

In summary, the influencing factors can be divided into three aspects: individual students, families, and schools, which respectively involve personal differences, non-cognitive abilities, and learning interests; Parent-child communication, parental educational expectations, family social status, and parental cultural level; School atmosphere, teacher support, and learning environment however, as the two main environments for students' learning, family and school have complex and dynamic interactive mechanisms. Family factors may affect students' learning engagement, while school factors may also affect students' learning engagement. Therefore, students' learning engagement process still needs further exploration.

LEARNING ENVIRONMENT

The concept of a learning environment

The learning environment has been a popular topic for researchers in education in recent years. The learning environment directly affects students' learning and development, which can be divided into school and extracurricular learning environments, such as family and social environments. Many researchers have focused their research on the learning environment in schools, believing that the school ecological environment in which students live can affect their cognitive, emotional, behavioral, and other aspects of development. Numerous studies have defined a learning environment as a perceived learning environment (Guo et al., 2021) and pointed out that students' subjective perception of the learning environment directly affects learning more than the objective environment (Asikainen & Gijbels, 2017).

Foreign research studies on the learning environment

Lewin (1936) introduced the important concept of "field" into the field of psychological research and proposed the social psychological work model, which considers a person's behavior to be a function of two variables: the individual and the environment. The needs pressure model proposed by Murray (1938) also emphasizes that behavior results from the interaction between individuals and their environment. Wade (1935) believes that schools are an important part of students' living environment and have a certain impact on them. However, the learning environment has not yet been regarded as an independent research field during this period. In the 1940s and 1950s, with the development of psychological science, as well as the need to expand the education system and scale, innovate educational content and methods, and develop new teaching technologies and methods, research on learning environments was, to some extent neglected (Tian, 1995). However, some scholars still have conducted relevant research, and this stage of research has expanded the perspective of learning environment research, studying the learning environment from an ecological perspective and believing that schools are a significant and far-reaching ecological environment (Fan, 1995).

In the 1960s, due to international competition, Western countries began to pay attention to the quality of education. The new curriculum reform focused on the education process, student psychology, textbooks, teaching methods, and other aspects. Researchers in education have begun to design and create learning environments based on human physical and mental development needs. During this period, the learning environment has become a relatively independent research field, and the number of related empirical studies has continued to increase. In the early 1960s, researchers focused more on the classroom physical environment, exploring the impact of physical factors such as space, light, sound, and temperature in schools on students' learning and drawing significant research data and conclusions.

In the late 1960s, research on the learning environment focused more on the social psychological environment, collecting specific master data based on the perception of teachers and students towards the learning environment, focusing on the specific perception of teachers and students towards the learning environment and the relationship between the learning environment and students' learning development. In the subsequent decades of development, developing and using effective measurement tools to evaluate students' perceived classroom learning environment was an important progress in learning environment research. Moos (1974) expanded the scope of learning environments, and research content is no longer limited to traditional educational environments; it also involves nine other categories of social organizations or structures. He developed the Classroom Environment Scale in 1974. Since the mid to late 1970s, research has been conducted on the social and psychological environment in the learning environment. Researchers pay more attention to the school atmosphere and class environment.

Since the 1990s, with the rapid development of technology and the development of psychology, especially constructivist learning theory, many studies have explored the learning environment from the perspective of constructivist theory. The research at this stage focuses not only on the classroom psychological environment but also on the classroom physical environment.

Domestic research characteristics of the learning environment

The learning environment supported by technology has been a topic of long-term research in China. The existing research results have mostly focused on educational technology, such as online learning environments, mobile learning environments, smart learning environments, numerical simulation experiments, online live-streaming teaching, and research on artificial intelligence technology supporting education. Xue (2023) explored the characteristics of English learning motivation and self-regulated learning in an online learning environment and the correlation between the two. He believes that online learning motivation and self-regulated learning are two important factors that affect the effectiveness of online teaching. Zhang et al. (2019) studied the current situation and influencing factors of college students' classroom learning engagement in a smart classroom environment and found that students' engagement levels in behavior, emotion, and cognition have significantly improved. Xiong (2023) analyzed the learning engagement and influencing factors of college students in online live-streaming teaching and found that in online live-streaming teaching, learning motivation, self-efficacy, teacher support, and connected classroom atmosphere have a significant positive impact on students' learning engagement.

Although the proportion of empirical research on learning environments has increased in recent years, the overall research on this topic is still biased toward theory, and research on learning environments is mostly focused on the design and construction of learning environments. Although researchers have focused on the impact of learning environment on individual students, such as the study on the impact of perceived classroom learning environment on their learning styles by college students (Lu, 2010), the study on the impact of learning environment on academic achievement based on undergraduate talent cultivation (Yu et al., 2013), the study on the relationship between perceived university classroom learning environment, learning styles, and cognitive and emotional development by college students (Lu, 2012), and the study on the current situation of the learning environment in universities and its impact on the development of undergraduate students' abilities (Bao, 2020), etc. However, there is still relatively little empirical research on the learning environment.

LEARNING OUTCOMES

The concept of learning outcomes

The term “learning outcomes” was originally proposed by Eisner (1979), who believed that learning outcomes are the results obtained by individuals after participating in activities in some form, whether intentional or unintentional. Subsequently, researchers defined the concept of learning outcomes from different perspectives. One viewpoint is to analyze learning outcomes from the perspective of output. As Ewell (2001) proposed, learning outcomes are the multifaceted gains that students gain after receiving higher education, representing their progress and growth, mainly including the development of knowledge, skills, attitudes, and performance after graduation. Another perspective is to analyze student expectations. Fulks (2009) believes that learning outcomes refer to the goals and outcomes that students are expected to gain after studying a certain course or major, including the knowledge and skills they are expected to master while emphasizing that these goals and outcomes are specific and measurable. The Joint Committee on Standards for Educational Evaluation in the United States describes learning outcomes as expectations of students after completing specific learning, that is, the degree to which students gain knowledge and understanding, practical skills, attitudes and values, and individual behavior through coursework, professional learning, or degree attainment (Gullickson, 2003).

Research on the connotation of learning outcomes

A series of explanations have been made abroad on the content to be evaluated for learning outcomes, forming different perspectives on analyzing the connotation of learning outcomes.

The first viewpoint mainly emphasizes individual-level learning outcomes. In the 1980s, Astin (1985) proposed that the evaluation of excellent universities and high-quality undergraduate education should be directly based on the impact of higher education on undergraduate students. On this basis, Astin further proposed a quality view based on intellectual development, emphasizing that excellent universities can enable students to generate maximum value added in knowledge, skills, and personal development through university education (Gong & Lv, 2012). Chickering (1987) proposed the theory of self-identity development and seven vectors for college students' personality development. He believes that establishing self-identity is based on the development of abilities, emotions, self-nature, and interpersonal relationships and promotes the development of personal goals and the achievement of integration.

The second viewpoint also emphasizes the connotation of learning outcomes at the social level. For example, Bowen (1977) divided the achievements of university education into cognitive learning ability, emotional and moral development, and practical application ability. Among them, cognitive learning ability includes speech ability, quantitative analysis ability, general knowledge, logical thinking

ability, etc. Emotional and moral development includes changes in values and aspirations, self-discovery ability, emotional stability, etc. Practical application ability includes the desire to achieve goals, future aspirations, adaptability, leadership, etc.

The third approach proposes the content of learning outcomes from questionnaire development and implementation research. Pace (1984) pointed out in his research on the experience questionnaire for college students that learning outcomes can be measured from four dimensions: self-awareness, general education ability, intellectual enhancement, and understanding of science. Okada et al. (2011) examined the learning outcomes of college students from five aspects: problem-solving ability, subject behavior, social morality, international perspective, and foreign language proficiency.

The research on learning outcomes in China started relatively late but has also achieved certain results. For example, Ma and Chen (2007) introduced and analyzed the basic content of student development theory in American universities and pointed out the need to comprehensively and deeply study student development. While emphasizing student academic development, attention should also be paid to changes in emotions and behaviors. Luo and Chen (2007) introduced the background of the National Survey of Student Engagement (NSSE) in the United States. They summarized the survey process, evaluation indicators used in measurement tools, and application of survey data. Through an in-depth analysis of research on learning outcomes in the United States, Sun (2009) pointed out that learning outcomes are the relationship between student participation in teaching activities and student gains during school and should focus on examining changes in students' knowledge skills, attitudes, and values. Huang (2011) pointed out that the high attention paid to student learning achievement evaluation reflects the modern higher education teaching paradigm shift from teacher and teaching-centered to student and learning-centered.

THE RELATIONSHIP BETWEEN LEARNING ENGAGEMENT, LEARNING ENVIRONMENT AND LEARNING OUTCOMES

According to existing research, students' perception of the learning environment can predict their learning behavior, and learning behavior can predict their perception of the learning environment (Dent & Koenka, 2016). There is also a similar relationship between students' views on the learning environment and learning outcomes and between learning engagement and learning outcomes. In addition, students' perception of the learning environment can indirectly predict learning outcomes by predicting their learning behavior.

The relationship between learning engagement and the learning environment

Regarding the impact of the learning environment on learning engagement, researchers have found that the learning environment can significantly predict learning engagement (Zhang & Li, 2015). Optimizing students' learning environment can help increase their emotional learning engagement, and based on the learning experience of “Internet+Education,” it can better enhance students' learning engagement (Li & Ding, 2018). Yin and Ke (2017) found that clear teaching objectives and standards, common ability development, and moderate academic burden can positively predict students' learning engagement, while good teaching and learning freedom can negatively predict students' learning engagement. The main body that forms a part of students' classroom learning experience mainly focuses on the three roles of students, teachers, and classmates. Research has pointed out that teachers are one of the main sources of support for students in the classroom (Umbach, 2005). The more teacher support students receive in the classroom, the more they will be engaged in learning (Bryson & Hand, 2007).

There is relatively little research on the impact of learning engagement on the learning environment compared to the impact of the learning environment on learning engagement. However, studies still show that learning engagement has a significant predictive effect on the learning environment. The increase in students' engagement in learning is beneficial for their overall learning experience (Bryson & Hand, 2007) and has a certain impact on their academic emotions (Zhang, 2012).

The relationship between learning engagement and learning outcomes

Regarding the impact of learning engagement on learning outcomes, research has shown that college students' learning engagement positively impacts learning outcomes (Pascarella et al., 2010), and their learning outcomes depend on their learning engagement. Furrer and Skinner (2003) revealed that learning engagement can improve students' learning outcomes and professional maturity, reduce dropout rates, and positively predict learning performance. The relationship between behavioral engagement and learning outcomes is greater than between emotional and cognitive engagement and learning outcomes. Carini et al. (2006) found that compared to students with good academic foundations, students with poor academic foundations tend to achieve better academic performance through increased engagement in learning. Learning engagement can directly predict learning outcomes and critical thinking exam scores.

In terms of the impact of learning outcomes on learning engagement, extensive research has shown that learning outcomes also have a significant predictive effect on learning engagement. Fredricks et al. (2004) argue that students' personal achievement needs can affect their learning engagement. Most of the student's personal achievements come from academics. Students with different academic achievements often have significant differences in learning motivation and strategy use, and previous academic achievements can positively predict learning motivation and strategy use (Zhang et al., 2017). When students achieve a higher sense of achievement in their previous studies, they will invest more time and energy in their subsequent studies in order to achieve a higher sense of achievement satisfaction. When they have a low sense of achievement in their previous studies, based on the return on investment theory, they will consciously reduce their time and effort in subsequent studies.

The relationship between learning environment and learning outcomes

Regarding the impact of learning environment on learning outcomes, research has found that a more positive learning environment may reflect learners' willingness to experience the same learning experience again, resulting in lower turnover rates and better academic performance (Kuo et al., 2014). Researchers have pointed out that the course learning experience of college students can significantly predict their academic performance (Diseth, 2007) and common ability development (Wang, 2016), with effective classroom teaching in the classroom learning experience having significant predictive power on students' learning outcomes. Research has shown that teacher-student relationships and peer relationships have a significant impact on students' learning outcomes. Johnson et al. (1981) found that group discussion and cooperation can form good peer relationships among members, which can improve the learning effectiveness of each group member. Students with a more positive perspective often receive higher scores or academic grades. This relationship can occur even when scored by the only evaluator and even when students report their opinions before they know their final grades. College students' learning perspective and classroom experience can directly affect their learning outcomes (Shi & Guo, 2012), and teachers' high-quality teaching methods also significantly impact students' learning outcomes (Zhang & Li, 2015). Good teaching can positively predict learning outcomes and interaction between students and faculty is a powerful predictor of learning outcomes, while high school grades have little impact on learning outcomes (Guo et al., 2013).

Regarding the impact of learning outcomes on the learning environment, researchers have also found that the learning outcomes obtained by students can significantly predict their learning environment (Banfield & Wilkerson, 2014). Researchers such as Goetz (2008) have found that academic self-concept indirectly affects students' academic emotions by influencing academic performance, and this mediating effect is consistent across disciplines and genders. There is also a relationship between academic emotions and academic performance. Academic emotions directly predict academic performance and are also negatively affected by academic performance. Specifically, academic performance positively rewards positive emotional experiences and negatively rewards negative emotional experiences (Zheng, 2007). At the same time, academic emotions play a mediating role between academic control, achievement goals, and academic performance. Academic control and achievement goals affect academic performance by influencing academic emotions (Sun & Chen, 2010).

LIMITATION AND EXPECTATION

Through a review of both theoretical and empirical studies conducted by both domestic and international researchers, this study has uncovered numerous valuable insights into the complex relationship between learning engagement, learning environment, and learning outcomes among college students, thereby contributing to the advancement of higher education. However, despite these results, certain gaps persist.

While there appears to be a dynamic correlation between various dimensions of learning engagement, there is a dearth of empirical research in this area. Limited measurement methods for assessing learning engagement, primarily reliant on non-real-time measurements, pose a challenge. Furthermore, the lack of utilization of academic performance as a measure of learning engagement is notable.

Similarly, although empirical research on learning environments has increased in recent years, most studies still predominantly focus on theories and the design aspects of learning environments. There is a noticeable dearth of empirical investigations into the overall learning environment, with much of the existing research centering on its impact at the individual student level.

Regarding learning outcomes, existing research tends to adopt varied perspectives, including individual, social, questionnaire development, and implementation approaches, leading to a lack of specificity and comprehensiveness in evaluation methods. Moreover, previous studies have largely examined isolated variables, such as the relationship between learning engagement and outcomes in

North America or the correlation between learning environment and outcomes in Europe and Australia. There is a notable absence of research that integrates these dimensions to reflect their interrelationships.

Moving forward, there is a need for further empirical research to delve into the complexities of different dimensions of learning engagement, with the utilization of physiological sensors emerging as a promising avenue for assessment. Additionally, there is a call for empirical investigations into the holistic learning environment, diversifying evaluation methods and dimensions of learning outcomes.

Future research studies could explore the interplay between learning engagement, learning environment, and learning outcomes. Through this approach, researchers can contribute to bridging existing gaps, nurturing students, and enhancing the quality of higher education to propel China's development forward.

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