Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7, 326-341
2025
Publisher: Learning Gate
DOI: 10.55214/25768484.v9i7.8569

The relationship among psychological factors, teacher factors, and online learning effectiveness: The mediating role of student engagement

Xuan Zong[1*], Gapar Bin Md Johar[2]
[1,2]Management and Science University, University Drive, Off Persiaran Olahraga, Section 13,40100, Selangor, Malaysia; 321012022020048@pgc.msu.edu.my (X.Z.) mdgapar@msu.edu.my (G.B.M.J.).

Abstract: The effectiveness of online learning serves as a critical benchmark for evaluating the quality of online course learning. However, the factors influencing online learning effectiveness are multifaceted and complex. Drawing on existing literature, this study investigates the impact of psychological factors, teacher factors, and student engagement on online learning effectiveness. A quantitative causal-explanatory research design was adopted, with data collected via structured questionnaires. Structural equation modeling was utilized to analyze the mediating role of student engagement in the relationship between psychological factors, teacher factors, and online learning effectiveness. The findings indicate that both psychological factors and teacher factors significantly influence online learning effectiveness. Further validation through statistical analysis confirmed that student engagement plays a mediating role in the relationship between psychological factors, teacher-related factors, and online learning effectiveness. This study underscores the pivotal role of student engagement in enhancing online learning effectiveness. Based on these insights, several recommendations are proposed to improve college student engagement in online learning, aiming to provide theoretical support and practical guidance for advancing online education and fostering its sustainable development.

Keywords: *Online learning effectiveness, Psychological factors, Student engagement, Teacher factors.*

1. Introduction

Since the end of the 20th century, the application of internet technology in the field of education has been increasing. This stage marks a transformation in teaching models influenced by internet technology. The current reforms in teaching models are primarily the result of an upgrade in educational technology. Internet technology has changed the way people acquire, learn, and disseminate knowledge, resulting in unprecedented changes in teaching models. University students can learn through videos, audio, and animations, and many universities around the world have begun offering online courses. The emergence of mobile devices such as smartphones and tablets has altered both the teaching methods of educators and the learning methods of university students. Online teaching utilizes internet technology tools to impart knowledge to learners through remote online platforms, and this teaching method is not constrained by time and space.

With the rapid development of computer and internet technology, supported by national policies and driven by social demand, online learning has become a mainstream mode of learning, compensating for certain shortcomings of traditional education. The effectiveness of online learning is considered to be at least as effective as other teaching methods, especially classroom instruction and traditional face-to-face learning. If students cannot achieve the same level of learning through online courses as they do in physical classrooms, then implementing online education would be futile. Student engagement is a necessary condition for online learning and an important indicator for measuring the effectiveness of students' online learning. Student engagement is also a key factor affecting the effectiveness of online

History: Received: 1 April 2025; Revised: 6 June 2025; Accepted: 9 June 2025; Published: 3 July 2025
* Correspondence: 321012022020048@pgc.msu.edu.my

learning. Therefore, this issue has attracted the attention of researchers, policymakers, and planners in the field of education.

Wu [1] stated that the scale, scope, and extent of online learning are unprecedented in the history of higher education worldwide and represent the first experiment on a global scale. It has not only improved the information literacy of teachers but has also changed the form of education. The original universities had a "wall." At the same time, online learning has not only broken down physical barriers but also, to some extent, psychological barriers, forming a new educational form where everyone can learn anytime and anywhere. Additionally, online learning, as a new mode of learning that is available at all times, has been widely promoted in teaching.

From the perspective of school managers, the attitude towards online learning is relatively positive. According to a survey conducted by Wang, et al. [2] on online learning across 28 provinces and autonomous regions, the attitudes of different stakeholders towards online learning are as follows. Firstly, educational managers at the district and county levels demonstrate a positive attitude towards online learning, which is more supportive and encouraging. It is worth mentioning that district and county education managers also recognize the advantages of online learning, such as its suitability for personalized learning for students (61.41%), improving teaching efficiency (54.8%), compensating for resource shortages (41.9%), and addressing teacher shortages (27.34%). As many as 68.22% of managers even expressed a desire to incorporate online learning as a regular part of regional educational services in the future.

Secondly, regarding teachers' attitudes towards online learning, the attitude is positive but accompanied by anxiety. The statistical results from 2,401 teacher questionnaires show that over 50% of teachers believe online learning can meet students' learning needs. However, at the same time, teachers have many anxieties about online learning, with the main concerns being: teacher-student interaction (62.6%), course quality (52.1%), and device operation (58.6%). In terms of age, middle-aged and older teachers experience less anxiety regarding the organization of online learning and classroom presence compared to younger teachers. 72.6% of teachers wish to receive targeted training, especially older teachers who have a greater need for training in technology application. 31.78% of teachers face difficulties in using information platforms and tools, while 26.82% of teachers find the use of information platforms and tools relatively difficult. Regionally, urban teachers are more concerned about the classroom etiquette of service providers, software quality, and equipment operation, while remote teachers' pay more attention to the interaction between students and teaching.

From the perspective of willingness to use, there are significant differences in the future usage intentions of teachers with varying perceptions of the effectiveness of online learning; those who recognize the effects of online learning are more willing to use it. There are also notable differences in future usage intentions between teachers under 34 years old and those aged 45 to 55; as age increases, the number of those wishing to continue online teaching is declining.

From the students' perspective, overall, students have a positive attitude towards online learning and strong adaptability. The statistical results from 17,025 student questionnaires show that although 16.95% of students expressed some concerns, 83.05% of students still maintain a positive attitude ("surprised" accounts for 36.92%, "happy" accounts for 46.13%), mainly because students have a favourable view of online learning, such as the ability to set their own learning pace and having complete and visualized learning records. 61.46% of students believe they can quickly adapt to online learning and are willing to continue using this method for learning activities.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

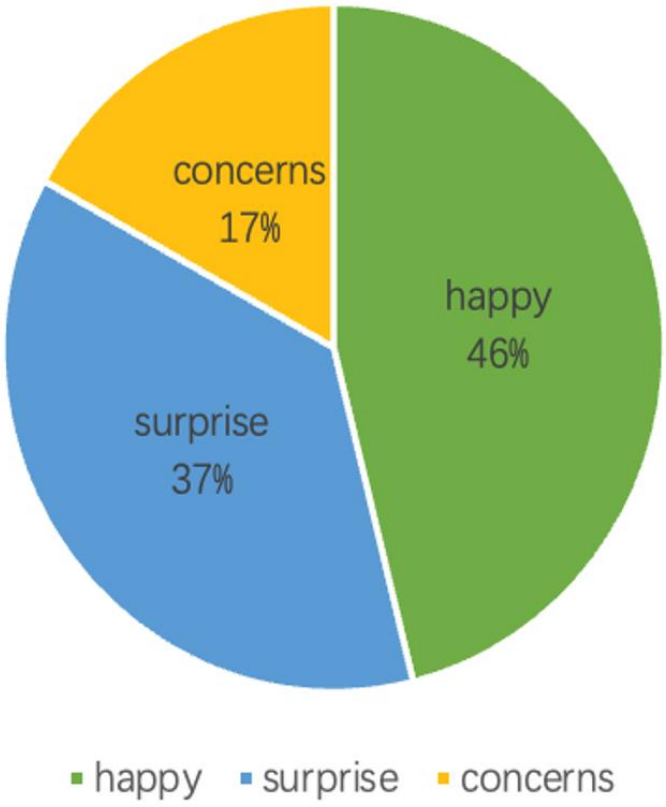

Figure 1.
Student attitude distribution.
Source: Wang, et al. [2].

The Ministry of Education of China and various schools have organized a variety of online courses. However, as a new educational model, online learning has many advantages and disadvantages. Online learning is different from traditional face-to-face classroom learning. In a classroom setting, teachers can interact with students, helping them better complete their learning tasks and adjusting teaching plans through certain teaching methods and strategies to improve learning efficiency. Due to the lack of cognitive and emotional communication between teachers and students in the online learning process, teachers may find it difficult to accurately control uncontrollable factors. Furthermore, in online learning conducted over the internet, factors such as the state of the online learning environment will affect students' online learning outcomes and the quality of the courses.

The essence of learning is a process in which a student's cognitive level continuously improves. Understanding the psychological factors that influence students' participation in online learning is crucial for enhancing the effectiveness of students' online learning. In this new form of education, online learning allows everyone to learn at any time. Although online learning can provide access to a wide range of knowledge, in practice, students often need to spend more time, especially when facing more difficult sections, requiring even more time, and many particularly challenging parts are more demanding. This is because online learning content is often self-directed, and students, as different independent individuals, are affected to varying degrees by different psychological factors regarding the learning outcomes of online courses. Additionally, during the process of learning through the internet, some students have weaker learning motivation and are easily distracted while online. There are also students who lack self-discipline and find it hard to resist the temptation of various entertainment

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

resources available on the internet. All these factors make it difficult for students to achieve good learning outcomes during online learning.

Students' learning cannot be separated from teachers' guidance. As a new online education model, online learning enables teachers to disseminate knowledge through innovative teaching methods during the online teaching process, such as videos, audio, and animations. The emergence of mobile devices such as smartphones and tablets has changed teachers' teaching methods, allowing them to impart knowledge to learners through remote online platforms, thus eliminating the limitations of teaching time and space. This differs from traditional classroom learning because online learning occurs in an online environment. In a traditional classroom, teachers and students share the same physical space and time, where teachers often employ lecturing and guiding methods to help them take a leading role in class. Through this approach, teachers can supervise the entire teaching and learning process, which benefits teachers in understanding the teaching processes and students' skill mastery in traditional classrooms. However, the physical distance between students and teachers in online learning hinders effective communication and interaction, leading to a lack of practical skills.

There is a lack of interaction between teachers and students in online learning. When using the traditional lecture-style teaching method in online teaching, due to the absence of the campus environment and classroom learning conditions, there is a lack of interaction and a poor learning atmosphere between teachers and students at the same time and in the same space. The single form of video lectures often causes students to lose focus and reduces their sense of participation as active learners. The participation of students and the learning effect face unprecedented challenges [3]. Moreover, in online teaching activities, the severity of the teaching attitude and the timeliness of teacher feedback greatly affect the participation of online learning students and significantly reduce the effectiveness of online learning.

Based on the above discussion and literature support, it can be seen that although a large number of studies have shown that the factors influencing students' participation in online learning have a significant impact on the effectiveness of online learning. However, the specific factors affecting the learning effect of online learning are not clear and are still in the stage of research and exploration. The research on the factors affecting the learning effect of online learning is very complex. The learning effect will vary in different teaching environments and backgrounds, and the factors affecting the learning effect are also diverse. Therefore, in the online learning environment, whether students can fully devote themselves to learning and actively participate in various online learning activities is the key to ensuring students obtain good learning effects. Understanding the influencing factors of online learning participation is crucial for improving the effectiveness of online learning. However, the in-depth analysis of the indicators affecting the participation in online learning is still at the stage of research and exploration. Therefore, it is necessary to continue to explore which factors affect the learning effect in the online learning situation.

2. Literature Review

2.1. Effects of Psychology Factors in Online Learning

During the process of online education, students become the center of learning and the leaders of the learning process. In the online education environment, students engage in online learning, which places higher demands on their intrinsic learning motivation and learning attitude. Motivation is a tendency to be stimulated and maintained, triggering and sustaining students' learning behaviors and directing them towards certain academic goals. The relationship between motivation and behavior is very complex. In the same person, there are multiple motivations for behavior. Psychology holds that when people have needs, they develop intrinsic motivation, which is the motivation. This intrinsic motivation drives people to choose a goal and achieve it, thereby satisfying the needs. After the needs are satisfied, new needs arise, and new behaviors begin, and this cycle repeats [4].

In online learning, students learn in an environment separated from teachers and students, and in a virtual environment based on information technology. For online learning, students are expected to

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

actively engage in online learning, not relying on the guidance of on-site teachers, and consciously follow teaching videos and teaching resources for learning. Students should consciously resist the temptation of various online entertainment resources and complete online learning tasks on time [5]. Only when students actively participate in online learning can effective online learning be achieved. Learning motivation is one of the most important psychological factors affecting the participation of online learning students. Students with higher intrinsic motivation can better adapt to the online learning environment.

Online learning has gradually become a new way of teaching and learning for college students. During online learning, self-regulation exerts a continuous and stable internal influence on learners' learning, which is a key internal factor for effective online learning. Self-regulation refers to the thoughts, emotions, and actions generated by oneself, which are planned and regularly adjusted to achieve personal goals. Self-regulation is the student's ability to control learning behaviors and thinking processes during the learning process. It refers to learners actively participating in learning activities, adopting appropriate learning strategies, judging, adjusting, and correcting specific learning tasks or processes to improve the effectiveness of online learning [6]. This includes setting learning goals and constantly monitoring their own learning progress, as well as flexibly adjusting learning strategies. Students with higher self-regulation skills can better cope with difficulties and challenges in learning, thereby motivating them to continue learning and persisting [7].

Online learning requires learners to have autonomy and self-regulation skills to be effective. Studies have shown that students with strong self-regulation learning abilities have better planning ability, reflection ability, and independent learning ability in online learning; while students with weak self-regulation learning abilities are prone to academic procrastination and often have poor learning quality. According to the viewpoint of American educational psychologist Zimmerman, self-regulated learning is when learners actively participate, monitor, and regulate in the learning process, guiding the learning process in multiple aspects of knowledge and skills acquisition to achieve certain goals. Self-regulated learning ability is a key factor predicting online learning academic performance and is an important prerequisite for academic performance levels in the online learning environment [8]. Due to the lack of face-to-face supervision and management in online learning, teachers have higher requirements for learners, requiring them to self-manage and control the entire learning process, ultimately transforming into self-regulating learners.

The self-regulation level of college students has become an important influencing factor for ensuring learning participation and learning effectiveness. The success of learners in online learning depends to a certain extent on their online self-regulated learning ability [9]. Research has found that the application of self-regulated learning strategies can predict students' academic performance. Scholars have discovered that the time, environment, and effort regulation of self-regulated learning by learners in the online learning environment are significantly related to their academic performance. Niu [10] proposed that self-regulated learning will have a significant impact on students' academic participation behavior Niu [10]. Qian [11] pointed out that strengthening college students' self-regulated learning ability can effectively promote their learning participation, which is the current focus of teaching processes and teaching designs [11]. Therefore, we believe that self-regulation is crucial for students' participation and the effectiveness of online learning.

In addition, self-efficacy affects the intention to participate in online learning. Self-efficacy has been found to be one of the important factors influencing students' stickiness in the online learning environment based on the network, and also determines the effectiveness of online learning. At the same time, self-efficacy is also considered to be the main psychological factor for students' success. During online learning, learners often feel afraid of difficulties, and when encountering difficulties or setbacks in learning, they are prone to feel frustrated, hesitate whether to continue learning, and even want to retreat or give up, thereby reducing learning self-efficacy and affecting learning outcomes. Some studies have concluded that there is a significant negative correlation between academic procrastination and academic self-efficacy. Research on academic procrastination and academic self-efficacy reveals that the

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

higher the academic procrastination, the lower the academic self-efficacy. In the online teaching environment, students are more likely to procrastinate in learning and even give up learning without supervision. The participation in online course learning is low, and the phenomenon that students cannot complete homework on time and actively is more common. Some people also point out that the out-of-control mobile phone dependence can predict students' self-efficacy in learning ability and learning behaviour, and in the survey, 53.83% of students have the phenomenon of mobile phone addiction, which seriously affects the academic development of college students [12].

Self-efficacy is a powerful indicator of students' academic performance. Those who have a high degree of confidence in their own abilities have a strong sense of efficacy, and self-efficacy can also help students adapt and cope with the new learning environment [13]. Those with high online learning self-efficacy in online courses may have a higher level of learning participation, and learners are more willing to continue learning and complete course tasks. On the contrary, learners with low online learning self-efficacy may lack confidence in participating in online courses [14]. Based on the previous theoretical and empirical studies, it can be reasonably inferred that online learning self-efficacy may be related to learning participation and affect the effectiveness of students' online learning.

2.2. Effects of Teacher Factors in Online Learning

At present, the remote training for domestic teachers is still in its infancy, especially compared with developed countries, there is still a considerable gap. As pointed out by a professor from South China Normal University, the current practice of teacher remote training is disconnected from the theory, lacking new theoretical research, resulting in teachers currently being in a low-level state of "blind" development and replication in online teaching [15]. Through empirical research, it has been found that there are many problems for teachers in online teaching. In synchronous interactive classrooms, teachers and students use video conferencing software such as Tencent Meeting, DingTalk, and Zoom, which has the advantage that teachers and students can turn on microphones and cameras to achieve "face-to-face" communication; teachers and students share screens to facilitate viewing and explaining course content, maximizing the simulation of a real classroom. However, some students still find the interaction unsatisfactory. The main manifestations are: in the past, students were more likely to find teachers for communication before, during, and after classes to solve various learning problems, but online classes are limited by the course time, especially it is difficult to "catch" teachers before and after classes, some students feel a lack of "casual communication time" with teachers. Some students feel they have no time to communicate with teachers. In addition, in online courses, some teachers only focus on explaining the course and building course resources, while neglecting communication and interaction with learners. Some teachers only interact with students occasionally when arranging learning tasks and assigning homework, and then there is no interaction between the teacher and the students for a long time [16].

During the online teaching process, the questions raised by learners on the platform have not been promptly answered by teachers, the discussion viewpoints assigned by teachers have not been commented on by teachers, and sometimes the discussions deviate from the original direction. However, due to the lack of interaction between teachers and students, timely correction cannot be obtained; some teachers, although also interact with students, use harsh wording and lack patience. All these lead to poor interaction between teachers and students and a distant teacher-student relationship. In the online learning process, good teacher-student interaction is very important for enhancing learners' sense of belonging, self-confidence, and responsibility. Regarding the enhancement of teacher-student interaction, remote education expert Moore pointed out that the interaction in remote education consists of three types: student-to-content, student-to-teacher, and student-to-student interaction. Among these three types, the interaction between teachers and students is the most important. The interaction between teachers and students in remote education is very important, and achieving the same level of teacher-student interaction as in traditional education is never easy in remote education. Teachers can only achieve this through great efforts. Similarly, some researchers have pointed out that

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

the interaction between teachers and students is indispensable in remote education, and only through two-way interaction between teachers and students can remote education proceed smoothly.

By promptly understanding the learning situation of students to enhance the interaction between teachers and students, teaching and learning can proceed more smoothly. The ways of interaction of teachers in online teaching can be in various forms, including oral communication, written feedback, and video interaction. Each type of interaction may stimulate different learning motivations of students. Research shows that face-to-face communication is particularly effective in promoting students' emotional recognition, enabling them to feel the teacher's care and support during the learning process, thereby enhancing their learning enthusiasm. In the context of online classrooms, if teachers can effectively use video conferencing tools to promote real-time interactive discussions, it can significantly increase students' participation and presence [5].

Furthermore, the feedback mechanism of teachers plays a crucial role in the interaction process. When there is a lack of timely feedback from teachers during the learning process, students may overestimate their ability to understand the learning materials. This may have a negative impact on the subsequent learning process. When learners encounter difficulties in their learning, whether they can receive timely help has a very significant impact on whether they can actively participate in the learning. Some teachers only focus on the quality of online courses, but fail to follow up on learning feedback. The difficulties that learners encounter during the learning process cannot be solved in a timely manner. For example, if a learner's questions about learning in class cannot be resolved after a week, the enthusiasm for learning that was originally present gradually fades away, even disappears, and the learner's mindset changes from being hopeful to being full of disappointment. If the learner's learning difficulties are not resolved in a timely manner, it is not conducive to their active participation in learning.

The active participation of students in the learning process and the help provided by teachers contribute significantly to the effectiveness of the learning process. Timely and specific feedback can significantly help students understand the learning materials more deeply and make necessary adjustments to their learning strategies. The quality of interaction between teachers and students in online learning depends on the speed and degree of interaction. Speed is considered the timeliness of feedback, while degree is the controllability of the interaction form and the breadth and depth of the interaction content. In online education, teachers and students must maintain timely and continuous interaction, which is a key factor for the effectiveness of online education.

Effective feedback not only helps students identify their strengths and weaknesses, but also stimulates learning motivation, thereby improving learning outcomes. However, the quality and manner of feedback directly affect its effectiveness. First, teachers should ensure that the feedback is targeted and specific, avoiding vague evaluations. Secondly, timeliness is also an important feature of feedback. Research shows that the closer the feedback is to the time when the task is completed by the student, the better the effect. Therefore, teachers should try to provide feedback as soon as students complete their homework, so that they can quickly apply it to subsequent learning. In addition, diverse feedback methods can also enhance students' acceptance. Besides written feedback, teachers can also encourage students through face-to-face discussions and written comments, thereby creating a positive learning atmosphere. Finally, teachers should also pay attention to emotional factors when providing feedback. Positive and constructive feedback can enhance students' confidence, encourage them to learn from failures, and not feel frustrated or give up. Therefore, when designing feedback, teachers should balance cognitive and emotional aspects to help students establish a positive self-perception during the learning process and form a motivation for continuous learning. Through these measures, teachers' feedback will more effectively promote the all-round development of students [17].

In addition to the above factors, teacher support is also an important factor. Teacher support refers to a series of positive actions taken by teachers to improve the learning quality of learners, in order to meet the learners' autonomy, ability and psychological needs. Teacher support mainly includes two aspects: emotional support and academic support. When teachers provide guidance and assistance to learners in terms of both academic and emotional aspects, learners tend to show higher levels of

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

learning engagement and communication interaction, and are more likely to achieve good academic results. Research shows that when learners feel supported by teachers or other learners, and their autonomy and ability needs are met, it can promote the formation of learners' self-efficacy and aspiration, thereby leading to better academic achievements. The teacher's concern, empathy and identification with learners can provide basic psychological needs for online learners. The more teacher support that students perceive, the lower their burnout level. Teacher support affects students' academic effort through influencing their autonomy. Students who perceive more teacher support are likely to improve their ability levels, develop a more positive learning attitude, and be able to more effectively utilize various learning strategies to achieve more learning benefits [18].

The relationship between teacher support and students' learning engagement in traditional teaching environments has been studied. It was found that when students perceive teacher support, they tend to show higher levels of learning engagement. Teachers' positive support behaviors towards students can improve learning outcomes. The level of teacher support for students may be related to their academic performance. Research shows that students who perceive high levels of teacher support have higher academic performance than those lacking such support. The positive student engagement experience from teacher guidance and motivation can significantly promote the development of emotional engagement in learning. Emotional support serves as the foundation for establishing a positive relationship between teachers and students. The care, understanding and encouragement provided by teachers can significantly enhance students' self-esteem and sense of belonging. Through the use of context-guided experimental methods, a systematic analysis of the factors affecting students' emotional engagement in learning was conducted, and finally the conclusion was drawn that teacher support has a significant impact on students' positive emotions and learning engagement in learning [19].

In terms of emotional support, teachers establish a positive teacher-student relationship, making students feel cared for and understood, thereby enhancing their self-confidence and learning interest. Academic support is reflected in teachers effectively transmitting and guiding course content, providing timely feedback and assistance to promote students' progress in knowledge acquisition. In addition, teachers should also provide social support to help students build good interpersonal relationships and enhance their sense of belonging in the school environment. To further enhance the effectiveness of teacher support, teachers must participate in continuous professional development to improve students' learning outcomes.

2.3. Effects of Student Engagement in Online Learning

As a prerequisite for effective learning, student engagement has been extensively studied in educational psychology over the past two decades. Although scholars have lacked consensus on theoretical models and methods, engagement is generally regarded as a multi-dimensional concept. As a behavioral concept, student engagement typically involves the following characteristics: high attention, active participation, and total commitment to learning. The most widely accepted engagement model is Fredricks, et al. [20] three-dimensional model, which includes behavioral engagement (such as the quality and quantity of active participation in learning), emotional engagement (such as emotional responses to learning activities), and cognitive engagement (such as mental activities during the learning process) Fredricks, et al. [20]. Qureshi, et al. [21] found that students who engage in the learning process tend to perform better than other students, recognizing the positive impact of student engagement on learning outcomes. Studies have shown that there is a correlation between student engagement and final learning outcomes. High-performing students exhibit significantly higher average engagement levels than low-engaged students, and the average performance of high-engaged students is significantly better [21]. Some research has utilized Bayesian models and time series data frameworks to analyze the behaviors of individual and group learners in online courses, revealing that high-achieving learners have a higher level of engagement in the course. Similarly, some research has found that online learning engagement has a direct positive impact on the online learning outcomes of a group

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

of college students. This confirms the correlation between online learning engagement and learning outcomes [22].

Learning engagement, as an important indicator for evaluating the learning process and predicting academic performance, has received extensive attention from scholars both at home and abroad. The online learning engagement of learners is not only influenced by external factors such as the online learning environment, teacher-student interaction, and course quality, but also by internal factors such as learners' personal motivation, self-regulation, and self-efficacy. Moreover, learning engagement is not only manifested in external behaviors but also reflected in the emotional and cognitive dimensions of learners. In this study, learning engagement is regarded as a unified entity of behavioral engagement, cognitive engagement, and emotional engagement, and it positively predicts the academic achievements of learners. Clearly, online learning engagement, as an inevitable mediator between learning outcomes, highlights the predictive value of studying student engagement for learning effectiveness.

3. Objectives and Hypothesis

The main purpose of this study is to explore the influence of students' psychological factors and teachers' factors on the effectiveness of online learning. Furthermore, by considering student participation as a mediating variable, the influence of students' psychological factors and teachers' factors on the effectiveness of online learning is analysed. To clearly understand the overall goal, it is divided into the following three specific objectives:

1. To examine the influence of psychological factors and teacher factors on student engagement.
2. To analyze the importance of psychological factors and teacher factors on online learning effectiveness.
3. To study the mediating effect of student engagement between psychological factors, teacher factors, and online learning effectiveness.

Based on the research objectives and the comprehensive literature review presented above, the following hypotheses are proposed:

H_1: There is a relationship between psychological factors and student engagement.

H_2: There is a relationship between teacher factors and student engagement.

H_3: There is a relationship between psychological factors and online learning effectiveness.

H_4: There is a relationship between teacher factors and student online learning effectiveness.

H_5: There is a relationship between student engagement and online learning effectiveness.

H_6: Student engagement mediates the relationship between psychology factors and online learning effectiveness.

H7: Student engagement mediates the relationship between teacher factors and student online learning effectiveness.

4. Methodology

This research utilizes a quantitative approach and follows a causal explanatory research design as outlined by Creswell and Creswell [23]. The study starts with an extensive review of relevant concepts and prior research, which is then used to formulate hypotheses for empirical testing. The quantitative method is employed to evaluate concepts, validate facts, analyze relationships between variables, and interpret the findings to draw meaningful conclusions.

Data analysis employs descriptive and inferential statistics. In this study, descriptive statistics were used to calculate indicators such as mean, standard deviation, and frequency distribution, providing a preliminary overview of the data and helping us understand the basic situation and distribution characteristics of the sample. In terms of inferential statistics, we employed the method of structural equation modelling to test and explore the relationships between variables and their significance. The data analysis statistics utilized two commonly used data analysis software, SPSS 27.0 and Amos 26.0.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

5. Results

The main research group of this study is about the effectiveness of online education for college students in Liaoning Province, Dalian City, and the influencing factors. Therefore, based on the official website data of the Liaoning Provincial Education Bureau, there are a total of 21 undergraduate colleges in Dalian City, Liaoning Province. The target population of this study includes college students from these 21 universities. Moreover, the target population must have participated in the online courses of their respective universities. The formal questionnaire was distributed through Qiangkuang, and a total of 512 students filled out the questionnaire online. Among them, 24 questionnaires contained logical errors, repetitions, and time display less than 120 seconds. After eliminating the invalid questionnaires, 488 valid questionnaires were retained for data analysis. The effective recovery rate of the questionnaires was 95.3%. The demographic Information is shown in Table 1.

Table 1.
Demographic Information.

Basic Information	Category	Frequency	Percentage
Gender	Male	255	52.3
	Female	233	47.7
Experience in Online Learning	one semester	148	30.3
	two semesters	136	27.9
	three semesters	110	22.5
	four semesters or more	94	19.3

According to the data in the table, 52.3% of the male students and 47.7% of the female students were surveyed. The male-female ratio was basically balanced. Among the experiences used in the questionnaire survey, the number of people who used it for one semester was 148, accounting for 30.3% of the total. The number of people who used it for two semesters was 136, accounting for 27.9%. The number of people who used it for three semesters was 110, accounting for 22.5%. The number of people who used it for four semesters or more was 94, accounting for 19.3%.

Confirmatory factor analysis is an important basis for evaluating the rationality of a model. The Amos software can assist researchers in testing the fit of the model, deeply understanding the relationships among various variables, and exploring the potential causal mechanisms. Through structural equation modelling of the data, the key factors influencing the outcome variables can be identified, and the interactions among these factors can be further investigated. The normality of data is one of the assumptions of SEM. As we are using AMOS (SEM), we have to determine the distribution of data. We have examined the values of skewness and kurtosis for determining normality. We obtained the skewness value between +1 and -1 (lowest value: 0.042, highest value: 0.479) and kurtosis values between +2 and -2 (lowest value: 0.428, highest value: 1.052). For satisfying the normality condition, the value of skewness and kurtosis should lie between ±1 and ± 2, respectively [24]. Thus, our data is normally distributed.

Furthermore, we examined the multicollinearity of the data. Multicollinearity refers to the high correlation among variables, which leads to distorted or unstable parameter estimation in the model. In this study, using the SPSS 27.0 software, we checked for the presence of multicollinearity in the data set to identify whether there is collinearity among the predictor variables. Multicollinearity was examined using the variance inflation factor (VIF) [25]. Generally speaking, when the VIF value is less than 5, it indicates that there is no overlap among the independent variables. The data was analysed using Linear in the SPSS Analysis. The VIF values for all components ranged from 1.213 to 1.818, and all VIF values were below 5, indicating the absence of multicollinearity.

SEM comprises the measurement and structural models. The measurement model was tested through CFA. The CFA is carried out in AMOS 26.0 software. In general statistics, when determining whether the structural equation model is meaningful, the first step is to judge based on the calculation results of some fitting indicators. The main judgment indicators include: X^2/df should be less than 3 as

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

a relatively ideal standard, but less than 5 is also an acceptable level; GFI, AGFI, and NFI generally require these values to be greater than 0.8 to indicate that the model has a better fit ability, but greater than 0.9 indicates a better model effect. TLI and CFI must be greater than 0.9 to indicate a better model matching degree. RMSEA should be less than 0.08 to indicate a better model fit degree [25]. As shown in Table 2.

Table 2.
Fitting Indicators of CFA.

	Index	Level of acceptance	Actual Value
	X^2/df	<5 acceptable; <3 ideal	1.323
	GFI	>0.8 acceptable ; >0.9 ideal	0.973
	NFI	>0.8 acceptable ; >0.9 ideal	0.960
	IFI	>0.9	0.964
	CFI	>0.9	0.991
	TLI	>0.9	0.991
	RMSEA	<0.08	0.988
	X^2/df	<5 acceptable; <3 ideal	0.026

Based on the fitting index results obtained from the confirmatory factor analysis model diagram, it can be seen that the test result value of X^2/df is 1.323, which is less than the standard value of 3. The GFI index result is 0.973, the AGFI index result is 0.960, the NFI index result is 0.964, the IFI index result is 0.991, the CFI index result is 0.991, the TLI index result is 0.988, and the RMSEA index result is 0.026, which is less than the standard level of 0.08. These results indicate that all the fit indices of the model in this study have reached and exceeded the general standard values, so it can be concluded that the confirmatory factor analysis model presented in this study is effective, and the matching degree of the model with the collected survey data meets the standard.

Then, through the standardized path coefficients between the latent variables and the measurement items, the average variance extracted value (AVE) and composite reliability (CR) are further calculated. When the CR value and AVE value are higher, it indicates that the composite reliability and convergent validity of the questionnaire data are better. The specific judgment criteria are that the general standard for AVE and CR values is that the AVE value is greater than 0.5 and the CR value is higher than 0.7 [26]. In this study, the AVE of PFs is 0.540 and the CR is 0.778. The AVE of TFs is 0.542 and the CR is 0.780. Both the AVE and CR values of the data meet the standard, indicating that the reliability and convergent validity meet the requirements. As shown in Table 3.

Table 3.
Discriminant Validity.

	AVE	CR	TFs	PFs	SEs	OLE
TFs	0.542	0.780	**0.736**			
PFs	0.540	0.778	0.236	**0.735**		
SEs	0.578	0.804	0.552	0.612	**0.760**	
OLE	0.531	0.850	0.363	0.421	0.523	**0.729**

From the above table, it can be seen that the correlation coefficients between each latent variable are all less than the upper limit of the 0.85 standard value, indicating that there is a certain degree of correlation among these variables, but no excessive correlation has occurred. The square root of the AVE of each variable is also greater than the correlation coefficient between the variables, which fully demonstrates that each variable has good discriminant validity.

Structural models are a statistical method for analysing the relationships between variables based on the covariance matrix of variables. The structural model graph was established using AMOS 26.0. By analysing the results, all the hypotheses were supported by the data.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

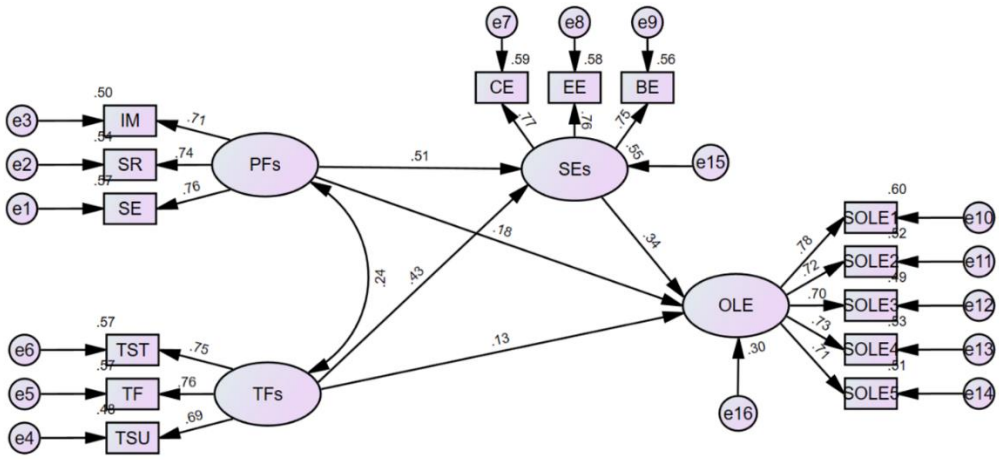

Figure 2.
Structural Equation Modelling.

According to the results of the path analysis, the standardized path coefficient of psychological factors on students' participation is 0.510 (C.R. = 9.017, $p < 0.001$), indicating that psychological factors have a significant positive influence on students' participation. Therefore, hypothesis H1 is established;

The standardized path coefficient of teacher factors on students' participation is 0.431 (C.R. = 7.784, $p < 0.001$), indicating that teacher factors have a significant positive influence on students' participation. Therefore, hypothesis H2 is established;

The standardized path coefficient of psychological factors on online learning effectiveness is 0.183 (C.R. = 2.528, $p < 0.05$), indicating that psychological factors have a significant positive influence on online learning effectiveness. Therefore, hypothesis H3 is established;

The standardized path coefficient of teacher factors on online learning effectiveness is 0.134 (C.R. = 2.017, $p < 0.05$), indicating that teacher factors have a significant positive influence on online learning effectiveness. Therefore, hypothesis H4 is established;

The standardized path coefficient of students' participation on student online learning effectiveness is 0.336 (C.R. = 3.763, $p < 0.001$), indicating that students' participation has a significant positive influence on student online learning effectiveness. Therefore, hypothesis H5 is established.

Table 4.
Path coefficient.

Paths			Estimate	S.E.	C.R.	P	Result
PFs	→	SEs	0.510	0.057	9.017	***	H1 supported
TFs	→	SEs	0.431	0.063	7.784	***	H2 supported
PFs	→	OLE	0.183	0.099	2.528	0.011	H3 supported
TFs	→	OLE	0.134	0.102	2.017	0.044	H4 supported
SEs	→	OLE	0.336	0.121	3.763	***	H5 supported

Note: * * * P < 0.001, * * P < 0.01, * P < 0.05.

The table below presents the analysis conducted in this study to examine whether there is a significant mediating effect among various variables in the data. The analysis was performed using Amos 26.0 software, employing the Bootstrap method, with a 95% confidence interval selected. The mediating effect was then calculated and tested through 5000 iterations of rotation within the software. The presence of a significant mediating effect was determined by observing the upper and lower limits of the 95% confidence interval in the result table as well as the significance P value.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

Table 5.
Bootstrap of mediated effect analysis.

Relationship			Estimate	Lower	Upper	P	Result
PFs→	SEs→	OLE	0.235	0.122	0.372	***	H6 supported
TFs→	SEs→	OLE	0.222	0.109	0.384	***	H7 supported

Note: * * * P < 0.001, * * P < 0.01, * P < 0.05.

The results in the table show that the indirect effect value of the mediating path from psychological factors → student participation → student online learning effectiveness is 0.235, with a 95% confidence interval of [0.122, 0.372], excluding 0, P < 0.001, indicating a significant mediating effect and supporting Hypothesis H6;

The indirect effect value of the mediating path from teacher factors → student participation → student online learning effectiveness is 0.222, with a 95% confidence interval of [0.109, 0.384], excluding 0, P < 0.001, indicating a significant mediating effect and supporting Hypothesis H7;

6. Discussion

This study verified the relationship between the psychological factors and teacher factors of online students and the online learning outcomes. The research shows that there is a significant positive correlation between students' psychological factors and their participation, and a significant positive correlation with the online learning outcomes. Further verification confirmed that the psychological factors of students' participation and learning play a mediating role in the relationship between students' online learning outcomes.

In this study, the three dimensions of psychological factors - self-efficacy, internal motivation, and self-regulation - also showed statistically significant correlations with students' participation and SOLE. Students with high self-efficacy are more likely to actively participate in online discussions and seek help, while students with low self-efficacy may choose avoidance behaviours due to fear or anxiety. The research results indicate that students' learning self-efficacy has a positive impact on online learning participation. Additionally, the level of motivation is also an important research direction. Students with strong intrinsic motivation tend to maintain a high level of participation in learning, so enhancing students' intrinsic motivation is the key to improving learning outcomes, which is consistent with the viewpoint of Seow, et al. [27]. Finally, the influence of the self-regulation factor on learning cannot be ignored. Students with strong self-regulation abilities can effectively regulate and control their thoughts, emotions, and behaviours. Students with positive self-regulation can improve their learning outcomes, while those with negative self-regulation may experience a decline in learning participation. Seow, et al. [27] in summary, students' psychological factors stimulate their participation, which in turn affects their learning outcomes.

Secondly, this study found that there is a significant positive correlation between teacher factors and student participation, and it also shows a significant positive correlation with the online learning effect. In this study, the three dimensions of teacher factors - teacher-student interaction, teacher feedback, and teacher support - all showed statistically significant correlations with student engagement and academic performance. Through positive interaction, teachers can not only better understand the needs and difficulties of students, but also establish a good interactive relationship with students. This interaction between teachers and students can enhance students' sense of participation in class and help them overcome difficulties in the learning process, thereby improving students' academic performance. This is consistent with other viewpoints. If there is more interaction between teachers and students, students' participation will increase [5].

Teacher feedback is also an important factor influencing students' online learning. Timely, specific and constructive feedback can help students recognize their shortcomings and improve their academic performance. Research shows that positive feedback from teachers can significantly enhance students'

participation and academic achievements. At the same time, timely feedback is also an excellent way for online students to integrate into the course and help them succeed in the course.

Teacher support also plays a crucial role in the academic development of students. This support is demonstrated by teachers' concern and understanding for their students, which can help students build self-confidence and a sense of belonging. Additionally, the guidance and assistance provided by teachers in academic matters can enable struggling online students to perceive the teachers' care and support. Similarly, studies have shown that students who receive adequate support are more willing to actively participate in their studies and achieve better academic performance [18].

Through further exploration, it was confirmed that students' investment plays a mediating role in the relationship between teacher factors and students' online learning outcomes. This indicates that in online education by teachers, showing positive attitudes towards students or establishing communication channels between teachers and students. These positive teacher behaviours will stimulate students' participation. This can be manifested as students being more actively engaged in the course, more frequently interacting with teachers online, completing homework and projects more conscientiously, etc. The high participation of students, in turn, will enhance the online learning outcomes of students. The efforts of teachers indirectly improve the online learning outcomes of students by increasing students' participation.

This study expands the influencing factors of learning engagement in the online learning environment of college students, and enriches the existing related literature. Although the multi-dimensionality of engagement has been fully studied in educational literature [22] there are currently few studies on the psychological factors, teacher factors, course quality, and online learning environment factors that affect learning engagement among college students. This study fills the gap in the existing literature regarding the influencing factors of online learning participation among college students. Previous studies have mostly focused on individual factors or technical factors, while this study constructs a comprehensive model to comprehensively consider multiple dimensions such as psychological factors, teacher factors, course quality, and online learning network environment, revealing how these factors jointly affect the mechanism of learning engagement. This discovery not only enriches the theoretical framework in the field of online learning, but also provides new perspectives and methodological foundations for subsequent research.

The results of this study provide valuable practical significance for university online learning, as the research has confirmed the importance of considering psychological factors, teacher factors, course quality, and the online learning environment in students' online learning. Moreover, we foresee that online learning will still completely transform higher education in the future. Therefore, the results of this study still have practical significance for higher education institutions and the Ministry of Education in seeking to ensure the effectiveness of online learning.

7. Conclusion

This study verified the relationship between the psychological factors and teacher factors of online students and the online learning outcomes. Further verification confirmed that the psychological factors of student participation and learning, as well as the teacher factors, play a mediating role in the relationship between students' online learning outcomes. The research indicates that student participation plays a crucial role in enhancing online learning outcomes. It is expected that in future research, more practical suggestions and solutions can be provided for researchers, educators, policymakers, and learners. It is hoped that by optimizing various factors of online learning, we can adapt to the changing demands and challenges of online education and promote the sustainable development of online education.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

References

[1] Y. H. Wu, "Analysis of online learning participation andinfluencing factors of vocational college students based on blended teaching," *Modern Business Trade Industry*, vol. 42, no. 19, pp. 123-125, 2021.

[2] D. D. Wang, H. B. Wang, W. Zhang, H. R. Wang, and X. P. Shen, "Research on online teaching in the period of "suspending classes without stopping learning"——based on 33,240 online surveys across the country," *Modern Educational Technology*, vol. 3, pp. 12-18, 2020.

[3] Q. H. Yao and J. Yan, "Investigation and research on the current situation of emotional support for college students' online learning teachers," *Digital Education*, vol. 2, pp. 33-40, 2022.

[4] T. Hongsuchon, I. M. M. El Emary, T. Hariguna, and E. M. Qhal, "Assessing the impact of online-learning effectiveness and benefits in knowledge management, the antecedents of online-learning strategies and motivations: An empirical study," *Sustainability*, vol. 14, no. 5, p. 2570, 2022.

[5] X. S. Xing and J. Li, "The new ideas for the development of online education in the "internet+" era," *China Educational Technology*, vol. 5, pp. 57-62, 2021.

[6] O. Wiberg, M. Khalil, and M. Baars, "Self-regulated learning and learning analytics in online learning environments: A review of empirical research," *Distance Education in China*, vol. 12, pp. 524-533, 2020.

[7] J. Lei and T. Lin, "Emergency online learning: the effects of interactional, motivational, self-regulatory, and situational factors on learning outcomes and continuation intentions," *The International Review of Research in Open and Distributed Learning*, vol. 23, no. 3, pp. 43-60, 2022.

[8] H. Y. Dong, "Research on current situation of college students' online self-regulated learning ability: A case study of an undergraduate college in Hainan Province," *Education and Teaching Forum*, vol. 5, pp. 30-37, 2023.

[9] X. M. Bai, H. H. Yin, and X. Q. Gu, "Who can succeed in online learning: A study of Ka K12 students' online self-regulated learning online ability and its impact," *Distance Education in China*, vol. 3, pp. 36-44, 2021.

[10] L.-G. Niu, "Decision-making determinants of students participating in MOOCs: Merging the theory of planned behavior and self-regulated learning model," *Computers & Education*, vol. 134, pp. 50-62, 2019. https://doi.org/10.1016/j.compedu.2019.02.004

[11] H. Qian, "On the important influence of college students' self-discipline ability on English education," *English on Campus*, vol. 14, pp. 3-5, 2020.

[12] L. A. Mamolo, "Online learning and students' mathematics motivation, self-efficacy, and anxiety in the "new normal"," *Education Research International*, vol. 2022, no. 1, p. 9439634, 2022. https://doi.org/10.1155/2022/9439634

[13] S. Y. Cha and G. F. Wang, "The relation between regulatory emotional self-efficacy and academic adaptation of college students: The mediating effect of academic self-efficacy," *Advances in Psychology*, vol. 11, no. 11, pp. 2477–2485, 2021.

[14] X. Y. Wang, "A research on the current situation and influencing factors of college students' online learning," *Chinese Journal of ICT in Education*, vol. 3, pp. 73-80, 2022.

[15] J. Miao, C. Jiangmei, and L. and Ma, "Teacher–student interaction, student–student interaction and social presence: Their impacts on learning engagement in online learning environments," *The Journal of Genetic Psychology*, vol. 183, no. 6, pp. 514-526, 2022. https://doi.org/10.1080/00221325.2022.2094211

[16] S. G. T. Ong and G. C. L. Quek, "Enhancing teacher–student interactions and student online engagement in an online learning environment," *Learning Environments Research*, vol. 26, no. 3, pp. 681-707, 2023. https://doi.org/10.1007/s10984-022-09447-5

[17] H. Y. Sha and Y. X. Mou, "Research on the sustained willingness and influencing factors of college students' online self-directed learning——an empirical analysis from the perspective of learners," *Journal of Guangzhou Open University*, vol. 1, pp. 8-16, 2024.

[18] Z. Y. Ma, "An empirical research on online learning effectiveness of adult learners based on AMOS: An analysis of the relationship among teacher support, self-regulated learning and learning performance," *Journal of the Open University of Guangdong*, vol. 31, no. 3, pp. 1-10, 2022.

[19] J. Han and X. Geng, "University students' approaches to online learning technologies: The roles of perceived support, affect/emotion and self-efficacy in technology-enhanced learning," *Computers and Education*, vol. 194, p. 104695, 2023.

[20] J. A. Fredricks, P. C. Blumenfeld, and A. H. Paris, "School engagement: Potential of the concept, state of the evidence," *Review of Educational Research*, vol. 74, no. 1, pp. 59–109, 2004.
[21] M. A. Qureshi, K. Asadullah, Q. J. Ahmed, R. S. Ali, and S. Q. and Yousufi, "Factors affecting students' learning performance through collaborative learning and engagement," *Interactive Learning Environments*, vol. 31, no. 4, pp. 2371-2391, 2023. https://doi.org/10.1080/10494820.2021.1884886
[22] C. P. Chen, Z. G. He, B. Zhang, and Z. Y. Tan, "Research on the relationship among college students' digital learning ability, learning engagement and learning effect in online learning," *Higher Education of Sciences*, vol. 2, pp. 72-80, 2023.
[23] J. W. Creswell and J. D. Creswell, "Research design: Qualitative, quantitative, and mixed methods approaches," *Journal of Social and Administrative Sciences*, vol. 4, no. 2, pp. 205–207, 2017.
[24] R. B. Kline, *Principles and practice of structural equation modeling*. New York: Guilford Publications, 2023.
[25] R. Panigrahi, P. R. Srivastava, and P. K. Panigrahi, "Effectiveness of e-learning: The mediating role of student engagement on perceived learning effectiveness," *Information Technology & People*, vol. 34, no. 7, pp. 1840-1862, 2021. https://doi.org/10.1108/ITP-07-2019-0380
[26] J. F. Hair, C. M. Ringle, and M. Sarstedt, "PLS-SEM: Indeed a silver bullet," *Journal of Marketing theory and Practice*, vol. 19, no. 2, pp. 139-152, 2011.
[27] A. N. Seow, S. Y. Lam, Y. O. Choong, and C. K. Choong, "Online learning effectiveness in private higher education institutions: The mediating roles of emotions and students' learning behaviour," *Quality Assurance in Education*, vol. 32, no. 2, pp. 180-196, 2024. https://doi.org/10.1108/QAE-07-2022-0128

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 7: 326-341, 2025
DOI: 10.55214/25768484.v9i7.8569