IMPACT OF FACULTY SUPPORT ON STUDENT ENGAGEMENT IN ONLINE LEARNING BEHAVIOR

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AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF EDUCATION IN EDUCATIONAL ADMINISTRATION (INTERNATIONAL PROGRAM)

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ABSTRACT

A twelve-week quasi-experimental study was conducted on the intervention of teacher support in the first-year college course of Advanced Mathematics in the Qingdao campus of Texas Institute of Technology and Vocational Studies as an example. The data were used to quantitatively analyze the variability of the three major types of learning behavior inputs: engagement, persistence, and interaction before and after the intervention, as well as to analyze the correlations between the six strategies of teacher support and the types of engagement, persistence, and interaction and their sub-dimensions. The results showed that there were significant differences in the types of interaction and engagement of students' behavioral engagement before and after the intervention, and there were significant positive correlations between teachers' instructional strategies, prompting strategies, explanation strategies and encouragement strategies and students' behavioral engagement in learning. The findings provide suggestions for optimizing the implementation of support strategies for frontline teachers and open up new paths for improving the quality of online learning.

Keywords: motivation theory, teacher support, emotional support, professional support, engagement in learning

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Tong Zhou

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Chapter 1
Introduction

1.1 Statement of the Research Problem

1.1.1 Problem Statements

In April 2018, the Ministry of Education pointed out in the Action Plan for Education Informatization 20 that it is necessary to improve the mooting service, bring together the strength of universities, enterprises and other parties to provide high-quality large-scale online open courses and achieve high-quality personalized learning experience. In the context of "Internet + education", the construction and application of online courses are in full swing in major universities. At the same time, due to the impact of the epidemic, the Ministry of Education announced the postponement of the start of the spring 2020 school year, and requested universities to make full use of online learning resources and actively carry out online learning activities to ensure the learning quality of college students during the epidemic. According to incomplete statistics, the cumulative number of colleges and universities in China during the epidemic was 1454, and 17.75 million college students participated, totaling 350 million people. In terms of the number of courses, 1.08 million teachers offered 1.07 million courses on the Internet, and these courses included theoretical and experimental courses, covering all subject categories. In terms of course types, they cover a variety of course types such as public courses, professional basic courses and professional courses, and in terms of delivery modes, there exist a variety of delivery forms such as live classes, recorded classes and catechisms. This shows that online learning is becoming increasingly important.

At the same time, there is growing concern about the quality of education under online learning, and it is generally agreed that the fundamental issue of education quality is how to ensure students' learning gains and personal growth, and that the key to achieving learning gains lies in students' active participation in academic activities, that is, learning engagement. Broadly speaking, learning engagement refers

to the amount of time and energy students invest in academic activities or tasks, and the higher the level of engagement, the greater the learning gains achieved. Students who are highly engaged in learning show a high level of enthusiasm, a strong interest in learning, a strong desire to learn, they put in effort and persistence, and they use cognitive strategies to actively deal with academic challenges and setbacks, thus achieving higher levels of learning gains and personal growth than students who are less engaged in learning.

In recent years, learning engagement has become the most talked about research topic in the field of educational psychology. A large number of theoretical and empirical studies have been conducted by scholars on how to enhance students' learning engagement and the role of learning engagement in influencing academic achievement. The results of these studies consistently find that learning engagement is a value-added process that can lead to effective initiatives for higher education quality. How to measure students' learning engagement and how to promote it effectively have gradually become key issues in educational quality reform worldwide. Moreover, The Programme for International Student AssessmentPISA also emphasizes that learning engagement can play an important role in the quality assessment process, and considers learning engagement as an important indicator of the quality of school education.

Although engagement in learning is crucial, students are not always engaged in academic activities on their own. Therefore, exploring the intrinsic mechanisms and external conditions that promote student engagement in learning is an important prerequisite for achieving the goals of the current educational reform and an important step in implementing today's "student-centred" view of educational quality, which requires adequate attention. Existing research shows that learning engagement is a variable state and can be influenced by the external school environment. For university students, teachers are the most important social actors in the learning environment, not only as practitioners in class, but also as designers and organizers of off-campus activities. Positive interactions between teachers and students can have a positive impact on students' learning behaviors, academic

emotions, and academic performance. Thus, teacher behavior plays an integral role in influencing college students' engagement in learning.

How can teachers have an impact on student motivation and academic achievement? Self-determination motivation theory suggests that the social environment's support for students' basic psychological needs can promote self-regulated learning behaviors and learning outcomes. In the school environment, teacher support is the primary source of support for students' needs and can directly contribute to the satisfaction of students' basic psychological needs. In turn, students whose psychological needs are met are more motivated to engage in academic tasks and achieve higher levels of learning gains and personal development. Thus, self-determined motivation theory provides a good theoretical basis for understanding the positive impact of teacher support. Corresponding to students' basic psychological needs, teacher support is specifically expressed as autonomy support, emotional support, and competence support. Students who perceive these aspects of teacher support have higher levels of perceived competence, interest in learning, and academic effort, are more willing to seek academic challenges, are more likely to persevere when faced with difficulties, are more willing to seek academic challenges, have more positive emotional experiences, use more effective learning strategies, and achieve greater learning gains.

Therefore, this study dissects the specific effects of teacher support on college students' learning behavior engagement based on the context of online learning environment based on perspectives such as motivation theory. At the same time, it explores the optimization strategies and ways of teacher support based on the model of online learning environment to provide new perspectives and ways of implementing teacher support in online teaching, aiming to develop effective teacher support strategies to promote college students' learning behavior engagement, provide useful guidance and help for frontline teachers to carry out online teaching, and thus improve the quality of online teaching.

1.1.2. Research Questions

Learning behavior engagement is a dimension of learning engagement that reflects the effectiveness of students' online learning process, such as the number of times they access resources, the time they spend completing tasks, and the quality of their participation in discussions. However, surveys show that students' satisfaction with instructor support and engagement in learning behaviors during online learning activities are not high, which is due to students' less frequent use of the platform's learning resources and their decreased willingness to learn actively and continuously, which affects the effectiveness of current university students' online learning. Therefore, the key issue to be addressed in online learning is the method teachers use to motivate students and motivate them to sustain their learning behaviors. The online learning environment is a double-edged sword that provides convenient access to teaching and learning, but also creates a temporal and spatial separation between teachers and students and makes it difficult to control the teaching and learning situation. Does teacher support perceived by students during the online learning process affect their learning behavioral engagement? How does teacher support affect students' engagement in learning behaviors? This study will explore the above questions.

1.2 Research Objectives

The purpose of this study is to explore and analyze the specific effects of teacher support on learning behavior engagement in an online learning environment through quasi-experimental research based on the design of teacher support strategies supported by motivation theory and expected value theory in an online learning environment, and on the basis of generalizing the dimensions of learning behavior engagement that have been studied. Based on the theoretical basis of teacher support, the experimental data and its quantitative analysis results, the two relationships between teacher support and learning behavior engagement in the online learning environment are clarified. On the one hand, it provides a reference value for the research on the role of teacher support on learning behavior engagement in online learning environment; on the other hand, the research

findings can provide optimization strategies for teachers' teaching in online learning environment. In order to provide new ideas for teachers to implement teaching support in the online teaching process and promote students' learning behavior engagement in the online learning environment.

1.3 Conceptual Framework

This study aims to explore the impact of teacher support on learning behavior engagement in an online learning environment by first reviewing relevant materials to design teacher support strategies in an online learning environment, define an analytical framework for learning behavior engagement in an online environment, and clarify the technical route for this study.

1.3.1 Design of teacher support strategies in an online environment

Combining the research needs, this study adopted Yushun Li's dimensional division of teacher support, which divided teacher support into two categories: professional support and emotional support, and specifically classified teacher support approaches into six categories: diagnosis, prompting, explanation, guidance, encouragement, and criticism through Yanyan Li et al.'s teacher support dimensional coding scale. Based on the relevant theories and design principles of teacher support, two types of proactive and trigger types were designed, and a total of six teacher support strategies and eight specific implementation tools are shown in Table 1.The frequency of teacher interventions was determined according to the teaching calendar and research needs, and the frequency of interventions was increased or decreased according to student status and teaching progress.

Table 1 Table of Teacher Support Strategies and Implementation Plan

dimensionality	Support Strategy	Forms of intervention	types	Frequency of interventions	Content of the intervention
Professional Support	diagnosis	Design and organize learning tasks, such as assigning tests to test students' mastery	proactive	Twicea week	Study quizzes are posted every Wednesday and Friday for one-on-one answers

	prompt	Use the materials feature to recommend reading materials for students that will help them learn the content and send them the key points in the course content	proactive	Twice a week	Use test results to grasp students' error points and provide extensions outside the classroom that will help them learn
		Use the platform to provide learning reminders when students' participation in learning falls below the target	flip-flop (electronics)	Twice a week	Lower than average number of visits to resources, participation in discussions, etc. and less than 20% of tasks completed Learning reminders
	account for	Targeted learning instruction for students	flip-flop (electronics)	Once a day	Daily discussion forum replies, private message replies to answers, etc.
	tuition	Provide students with pre-reading lessons before class	proactive	Once a week	Posting pre-reading lessons
		Guiding students to express their own views or opinions	proactive	Oncea week	Create a topic post on the discussion board based on the weekly learning content to generate students to join the discussion
Emotional support	encourage	Recognition of students with long effective learning time, high task completion and positive interaction	proactive	Once a week	Establishment of a weekly "Learning Star" honorary title, with additional points awarded
	critique	Teachers correct errors when students exhibit poor learning behaviors	flip-flop (electronics)	Once a week	Repeatedly failing to submit assignments, consistently falling below the assignment completion average, etc.

This study designed six support strategies in an online learning environment based on the theoretical basis of teacher support and supported by design principles, among which the diagnostic strategy was designed to stimulate and maintain students' interest and motivation by issuing learning tasks and active teacher-student interaction; the prompting strategy was designed to push effective learning resources, such as exercise sets and extended reading materials, to students to provoke their thinking and effectively Explanation strategies are designed to pay more attention to individual feelings and give students a sense of being valued and concerned, so that they can learn something; Guidance strategies are designed to stimulate students' initiative through various forms of guidance and motivate them to achieve the desired goals; Teachers' encouragement strategies can motivate and enhance students' self-confidence, boost their achievement

motivation and promote their positive development; Appropriate criticism also Appropriate criticism can also effectively stimulate students' intrinsic learning motivation and slow down students' learning burnout.

1.3.2 Definition of an analytical framework for online learning behavioural inputs

This study draws on prior research to select common characteristics of student behavior and establish an analytical framework for online learning behavior engagement. Li Shuang, a domestic scholar, has conducted a more in-depth study on the dimensions of learning behavior engagement in online learning environment, which has been adopted by more studies. He classified learning behavior engagement into six dimensions: engagement, persistence, concentration, interaction, academic challenge, and self-monitoring. Due to the unobservability of concentration, academic challenge and self-monitoring, this study adopts its three dimensions of learning behavior engagement based on online learning environment, which are interaction, engagement and persistence, taking into account the real environment and research needs. The seven behavioral engagement measures were also identified based on the features of the online teaching platform used in this study as shown in Table 2.

Table 2 Analytical framework for learning behavioral inputs in online learning environments

Type of behavioural input	subdimensionality	Examples of Platform indicators
interactivity	Teacher-student and student-student interaction	Platform discussion volume
participate in	show up on time for work	Number of sign-ups
	investment time	Platform visits
	Resource Access	Post the number of chapter quizzes, assignments completed
persevere with	Task adherence	Course assignment completion rate
	High investment is maintained	Maximum number of tasks completed by students
	overcoming difficulties	Number of students unlocking all learning tasks

Engagement refers to the time and effort invested in student access to the learning systems and task resources of the online platform and is expressed in three ways: attendance, access to resources and time investment in students' online courses; interaction refers to interaction, communication and collaboration between students and teachers or their peers based on features such as forums, postings and private correspondence provided by the learning platform; and persistence refers to students' persistent efforts in the face of difficult obstacles, slackness and stress. Sustained efforts to achieve learning goals are manifested in three ways: staying on task, maintaining a high level of engagement, and overcoming difficulties.

One of the most important indicators to measure the effectiveness of student learning is to focus on the state of students' learning behaviors, and learning behavioral engagement can effectively bridge cognitive engagement and affective engagement. Scholars at home and abroad have conducted in-depth research on the influencing factors, analytical frameworks, and measurement indicators of behavioral engagement in online learning, which provides a scientific theoretical and practical basis for this study, as well as a guiding direction for which behavioral performance of students in the online learning environment should be the focus of this study and how to proceed with the data. Instructional tools such as active teacher guidance, interaction, and providing effective learning strategies in the online environment have a positive contribution to stimulating students' student interest and thus enhancing their behavioral engagement. This also illustrates the need for teachers in online learning environments to create a more conducive learning environment and use more effective support tools in order to ensure that effective learning occurs in the time-separated online learning environment.

1.4 Research Hypothesis

Three research hypotheses on teacher support and learning behavioural engagement are proposed in conjunction with motivational theories and the literature based on research.

H1: The type of engagement in students' behavioral inputs to learning is significantly different before and after the teacher support intervention.

H2: The types of interactions in students' behavioral inputs to learning were significantly different before and after the teacher support intervention.

H3: Types of persistence in students' behavioral inputs to learning differed significantly before and after the teacher support intervention.

A total of six teacher support strategies were designed for this study: instruction, explanation, prompting, diagnosis, encouragement, and criticism. Six research hypotheses on teacher support strategies and behavioral engagement in learning are proposed in conjunction with literature research and theoretical foundations.

H4: There is a positive correlation between teacher explanation, prompting, diagnosis, guidance and encouragement strategies and the type of engagement in learning behavioral inputs.

H5: Teachers' critical strategies are negatively associated with the type of engagement in learning behavioral inputs.

H6: There is a positive correlation between teacher explanation, prompting, diagnosis, instruction and encouragement strategies and the type of interaction in learning behavioral inputs.

H7: There is a negative correlation between teachers' critical strategies and the type of interaction in the input of learning behaviors.

H8: Teacher explanation, prompting, diagnosis, guidance, and encouragement strategies are positively associated with the type of persistence in behavioral engagement in learning.

H9: Teachers' critical strategies are negatively related to the type of persistence in behavioral inputs to learning.

1.5 The Scope and Limitation of the research

1.5.1The Scope of the research

This study used the UMC online learning platform as the experimental platform to conduct a twelve-week teaching practice based on the course "Advanced Mathematics Upper Division", and the author independently implemented the teacher intervention. The experiment used a constant environment method, controlling the intervention and observation weeks for the same instructor, the

same group of students, and a uniform practice platform, curriculum, and content, and the intervention and observation weeks were the same six weeks. A total of six teacher support strategies were implemented in this study: explanation, diagnosis, prompting, instruction, criticism, and encouragement. The author was required to record eleven teacher support activities such as the time, content, feedback effect and time, and effect level of the support provided by the teacher as well as twenty-three learning behavior data of the students, such as daily visits, task completion rate, and minimum video viewing time. Also, the changes and feedback from the students' classroom were observed during the experiment to lay the groundwork for the subsequent data analysis.

1.5.2The limitation of the research

The preparation time for the research project was limited and due to the limitations of the experimental platform, only three dimensional changes in learning behavior inputs could be observed and the sample size was limited to one class in one school, which was not a wide enough sample. During the researcher's study, only general literature could be found and no in-depth discussion of the results could be presented, and only immediate conclusions could be drawn. There was subjectivity in the delineation and coding of dimensions of teacher support as no consistency test was conducted. There were many shortcomings and imperfections in the design and implementation of the experiment. The author will continue to enrich and complete the inquiry of teacher support on learning behavior input in other future studies. This study is only a preliminary exploration of the role relationship between teacher support and learning behavior engagement in an online learning environment, to provide scientific optimization strategies and improvement paths for online teaching practices.

1.6 The benefits of Research

1.6.1 Theoretical significance

This study designs teacher support strategies based on the theoretical foundations of motivation theory, expected value theory, and learning behavior

engagement, constructs an analytical framework for learning behavior engagement, conducts a quasi-experimental study to quantitatively collect data, and analyzes the specific effects of teacher support on learning behavior engagement in online learning contexts. It can provide a supplement to the research content of motivation theory, learning behavior input and other theories, teacher support strategies and the relationship between teacher support and learning behavior input, which is important to enrich and improve the relevant theories of teacher support, provide a new means to promote learning behavior input in online learning environment, and provide an effective and optimized way for the majority of front-line teachers to carry out online teaching.

1.6.2 Practical significance

Information technology tells development, online learning is becoming more and more involved in teaching and learning, and college students' learning engagement has become a central topic within the field of higher education in recent years. In the context of the epidemic, the learning engagement of college students in online learning practice is very unsatisfactory, and it is common for students to skip classes, not listen carefully, cope with classes, and not do homework. In such a current situation, it becomes crucial to improve the level of online learning engagement among college students. Therefore, an optimized way of teacher support strategy is proposed to provide new ideas to cope with the current thorny problems such as teachers' incompetence and students' isolation in online learning. After a thorough study of the dimensions and measures of learning behavior engagement, the strategy design of teacher support is cut into measuring the before and after changes of students' learning behavior engagement in online learning contexts, and clarifying the specific relationship between the two. On the one hand, it is beneficial for teachers to fully understand the importance of teacher support to students and educational activities; on the other hand, it can provide optimized strategies and ways for teachers to implement rationalized support, thus promoting students' learning behavior engagement in online learning contexts and improving the quality of online learning.

Chapter 2
Theory and Literature Reviews

2.1 Concept and Theories

2.1.1 Motivation theory

Motivation has long been a central topic of interest for educational psychologists. Motivation is considered to be a complex component of individual psychology and behavior that can influence the amount of time and effort an individual devotes to a given task, the feelings that develop about the task, and the degree of persistence. In academic contexts, the lack of adequate motivation to learn makes it difficult for even the brightest students to achieve long-term academic goals. In the field of educational psychology research, multiple theories of student motivation exist to explain students' behavioral choices, effort, persistence, and behavioral performance.

2.1.2 Motivational Motivation Model for Career Identity ARCS

In the field of psychology, motivation is explained as the underlying drive that a person relies on to produce and maintain active behavioral activities In 1983, Professor keller of Florida State University proposed that motivation to learn is an expression of students' active efforts to learn and their ability to identify learning goals through internal activities such as self-judgment. keller's ARCS model of motivation to learn provides teachers with a valid mental model of instructional design that can be widely practiced and validated.

Therefore, teachers can ask inspiring questions in the teaching process, such as attracting students' attention through hands-on experience, fun, and linking theory to practice; letting students know that what they are currently learning will be of great benefit to their future working life; providing timely physical and psychological emotional help to encourage students to solve problems at the source, so as to enhance their learning ability; creating a fun learning atmosphere, praising students'

excellence, and providing study guidance to students, such as explanation of knowledge points, diagnosis of learning effectiveness and encouragement, so that students can be fully engaged in their learning.

2.1.3 Self-determination theory and basic psychological needs theory

The self-determination theory proposed by Deci and Ryan is one of the motivational theories that is currently used in more research related to teacher support . The theory classifies human motivation into unmotivated, internal and external motivation and explains in detail the relationship between environment, motivation and student behavior. Basic psychological needs are an extension of self-determination theory and are the basis for the regulation of students' learning processes and the embodiment of behavioral outcomes. When the learning environment supports students to develop their abilities and stimulate their initiative, students gain a higher level of satisfaction and internal motivation to learn. Therefore, teachers, as the main actors in the learning environment, should provide timely and effective instructional support to promote a virtuous cycle of individual learning behaviors, cognitive and emotional engagement.

2.1.4 Expected value theory

The Expected Value Theory model first proposed by Atkinson (1957) was used to explain students' academic achievement behavior in a learning environment④ . Learning achievement behavior includes motivation for learning, students' expectations of success, and motivational dispositions. Among these, motivation for achievement includes the desire to succeed and the mindset to avoid failure; expectation of success is the student's judgment of successful task completion; and motivation tends to be the student's attraction to complete a specific task. Both the expectation of success and motivational tendencies are based on students' perceptions of specific tasks and environments, thus providing a theoretical basis for the study to design instructional support activities such as "learning quizzes" and "learning star" awards.

2.1.5 Learning behavioural inputs

Learning behavioral engagement is a part of learning engagement, and understanding the development of learning engagement can help to capture it more accurately.Schufeli proposed that learning engagement refers to the three dimensions of learning energy, effort, and focus.Caraway et al. divided students' engagement in school life into two levels: the individual level refers to students' emotions and behaviors; the group level refers to students' Kuh et al. define learning engagement as the time students spend on achieving learning goals and the actual effective learning activities during this time. According to Fredrick and Skinner, learning engagement includes three dimensions: behavioral, affective, and cognitive. Behavioral engagement in learning refers to the state of students' active participation in learning activities and tasks under the influence of the other two input dimensions. In recent years, most relevant national and international studies have adopted the idea of dividing learning engagement into three dimensions: behavioral, affective, and cognitive engagement in learning.

Learning behavioral engagement is the most intuitive and explicit behavioral state of students during the learning process. Numerous studies have shown that measuring and analyzing students' learning behavioral engagement during online learning can help analyze students' motivation to learn and thus assess students' external learning performance, which provides a solid basis for this study to measure data changes in learning behavioral engagement based on the implementation of teacher interventions. For example, Li explored the relationship between affective, cognitive, and behavioral inputs through a mathematical statistical approach, with the three dimensions correlating with each other. The results showed that learned behavioral engagement predicted and judged the degree of cognitive and affective engagement. Therefore, this study aims to explore students' behavioral engagement in online learning environments with the aim of being able to promote and improve behavioral engagement of online learning students and to provide optimized teacher support strategies.

2.2 Literature Reviews

2.2.1 Status of domestic research on teacher support

After searching in CNKI with "teacher support" or "teacher support services" and "learning support services" as keywords, we can find that the main contents of domestic and this thesis are The main content of teacher support is focused on the impact of teacher support, teacher support satisfaction, the mediating role of teacher support and teacher support strategies. Liu and Hai (2014) used students from six platforms as research subjects, and found that the three dimensions of teacher support, technical support and content design in online learning had the lowest satisfaction in students' minds. Liu Bin (2017) found that the overall level of teacher support as well as learning engagement perceived by students in the online learning environment was not high, with emotional support being the lowest. Luo Yun (2014) proposed that the more teacher support students perceive, the lower the level of student burnout. Qiao Hongxiao (2014) argued that students' perceived teacher emotional support is a negative influence effect on learning burnout through the mediating effect of self-efficacy. Qiao Hongxiao (2014) argued that students' perceived teacher emotional support is a negative influence effect on learning burnout through the mediating effect of self-efficacy. Liang (2017) found a significant positive correlation between undergraduate students' English independent learning ability and their perceived teacher support after a study. Ouyang, Dan (2005) mentioned that teachers hope to have an impact on students' academic performance through their support and academic self-concept thus(6) . Qiao Na (2013) used a questionnaire and the results showed that emotional support provided by teachers moderated the relationship between parents' family socioeconomic status and junior high school students' academic performance. Gao Lei (2016) found that teacher support was found to influence homework effort by affecting students' autonomous motivation. Ge Hongyan (2019) suggested that teachers' flexible and supportive strategies are highly attractive to young children and enable them to have a wonderful learning experience in the process of creativity. Lin Lijuan (2019) argued that teachers should use effective strategies to give positive guidance to young children's play.

2.2.2 Status of foreign research on teacher support

In the EBSCO database, we searched with the keyword "Teacher support", collected and read the literature, and found that foreign studies on teacher support related to this thesis mainly focused on the classification of teacher support dimensions and the impact results of teacher support.Malecki and Demaray (2003) proposed four dimensions of teacher support: emotional support, informational support, instrumental support and evaluative support.Robert C. Pianta (2006) classified teacher support into three dimensions: emotional support, competence support and learning support.Ryan and Patrick (2001) argued that teacher support can promote student-teacher interaction in self-efficacy and regulate learning behavior.Ricard and Pelletier (2016) after a study found that basic psychological needs support provided by teachers had a significant impact on students' motivation to learn.

2.2.3 Current status of domestic research on behavioral inputs to learning

In CNKI, we searched with the keywords "learning input" or "learning behavior input", collected and read the literature, and found that the domestic research on learning behavior input related to this thesis mainly focuses on the nature of learning behavior input, the measurement dimensions and the investigation of the current situation in several aspects. Vufati (2018) and others consider behavioral engagement as the result of more active, persistent and effective learning activities and behavioral performance. It is reflected in learning information exchange, use of learning resources, space, coordination methods and completion of learning tasks. Qu Yaohui (2019) showed that whether it is procedural behavioral engagement or substantive engagement, post-70 college students are more engaged and have more significant superior performance than post-90 college students before and after class. Peng (2013) proposed four dimensions of learning behavioral engagement for operational, cognitive, collaborative, and problem-solving behaviors. Yueya Sun (2015) divided learning behavior engagement into four stages: the initial stage of learning, the stage of acquiring knowledge, the stage of thinking and communicating, and the stage of reviewing. Li Shuang (2016), on the other hand,

divided it into six assessment dimensions of engagement, persistence, concentration, interaction, academic challenge, and self-monitoring. Liu Qingtang (2017) proposed four dimensions of engagement, focus, regularity and interaction. Zhang Qi (2018) divided the learning behavior input into four rubric dimensions of Persistence, Reflection), Initiative, and Concentration.

2.2.4 Status of foreign research on behavioral inputs to learning

In the database EBSCO, we searched with the key words "Learning Engagement", "Behavioral investment in learning", " Miles (2006) argues that behavioral investment refers to the amount of time invested in a task, persistence, effort and engagement, which are all related to high academic achievement and cognitive ability. time, persistence in learning, effort and engagement, all of which are associated with high academic achievement and cognitive ability.Skinner (2012) argues that behavioral engagement in learning is an interactive process between a student's dynamically constructed and sustained behavioral characteristics and the surrounding environment.Rose-Krasnor (2009) proposes that behavioral engagement in learning is a fundamental constituent dimension of learning engagement and is a link between affective engagement and Yibing Li's (2013) study pointed out that there is a bidirectional link between behavioral engagement in learning and affective and cognitive engagement, which can influence and predict students' affective and cognitive engagement.Skinner (2008) classified behavioral engagement in learning into seven measures of action goals, effort, persistence, depth, attention, mastery, and engagement. Duhita Mahatmya (2011) proposed four measures of time to complete the task, behavioural performance, engagement and depth of discussion.Lam (2014) classified them as active participation, focus and persistence.Hamane (2014) classified learning behavioural engagement into five measures of teacher-student interaction, cooperative learning, active learning, timely feedback and task persistence.

Chapter 3
Research Methodology

3.1 Population

This study was carried out in the first semester of the academic year 2021-2022, and the experimental subjects were 32 students of Computer 1 class of 2021 in Qingdao campus of Texas Institute of Technology and Vocational College, because they were freshmen, their initial understanding of the course content was more similar, the operation level of online learning was also similar, and they had just entered school, their learning style and study habits were more stable, and they were sensitive to their experimental responses, so the selection of The research subject is representative, and at the same time, I am a mathematics teacher, so the experimental study was carried out based on the example of the course "Advanced Mathematics Upper Class". The distribution of each basic information of the research subject is shown in Table 3.

Table 3 Distribution of information on study subjects

Experimental cycle	weeks	number of people	Ratio of men to women	grade
intervention week	6 weeks	32	Male 1: Female 2.2	first-year university student
observation week	6 weeks	32	Male 1: Female 2.2	first-year university student

During the experiment, students' behavioral input data were counted through the Umoja Learning online platform, which required recording the time of collection, cycle type, learning content, learning tasks, learning visits, daily visits, total number of tasks, average number of tasks completed, task completion rate, list of students who completed all tasks, number of students who completed all tasks, fastest completing students, highest number of tasks completed by students, highest number of tasks completed by students task rate, list of slowest completing students, number of slowest completing students, longest viewing time, shortest viewing time, average viewing time, number of chapter quizzes completed, number

of assignments submitted, number of daily discussions, and number of check-ins for a total of twenty-three online learning data items. Also, a total of eleven teacher support implementation data are required to be recorded for time of intervention, target problem, target of intervention, mode of support, type of support, content of intervention, student response, feedback or effect, time of feedback or effect, level of effect, and description of implementation.

In this case, the first week served as a buffer period to record the initial behavioral inputs of the students, in order to avoid behavioral input data being influenced by the personality characteristics of the student population. Therefore, the first week was an observation week in which no intervention was implemented, and the observation weeks were cumulative for one week. A six-week teacher support strategy intervention was conducted from the second week until the end of the seventh week, with a cumulative total of six weeks of intervention. The intervention was targeted according to the pre-determined teacher support strategies, frequency, and content. Teacher support strategies were implemented through the end of week seven, with weeks eight through twelve being observation weeks. To examine the change in students' learning status after the loss of online support from the teacher, this intervention was cumulative for five weeks. The total study cycle was twelve weeks, with a total of six observation weeks and six intervention weeks, beginning on September 7, 2022 and ending on November 27, 2021. During the observation cycle the teacher taught normally, taking the necessary instructional organization and guidance to allow the students to learn the course in their natural state, while recording data on learning behavior.

Finally, at the end of the course, the data on student learning behaviors recorded in the online learning platform, including the number of hours of study per week, the number of forum statements and the status of access to course resources, were aggregated and processed for variance and correlation analysis in the teacher support strategy implementation log sheet, statistics and analysis.

3.2 Data Collection

All data collection for this study was from student learning behavior data from

the UCM Learning Platform, adding and deleting behavioral measures needed for the study based on the established learning behavior input analysis framework. Student learning behavior data were recorded on a daily basis for twelve weeks and teacher support log sheets for six weeks. The frequency, type, and mode of teacher support interventions were used to record the effects and timing of feedback on student behavior to facilitate subsequent analysis of changes in behavioral engagement and teacher support strategies.

Among them, the teacher support record sheet was designed for later statistics on the frequency of support, according to two types of triggered and active types, six support strategies of explanation, instruction, prompting, diagnosis, encouragement, and criticism, providing different intervention contents and methods, and recording related data by date. The data recording form for learning behavioral engagement was recorded in detail according to the analytical framework of learning behavioral engagement in an online environment, according to the three main types of engagement, interaction and persistence and the measures of learning behavioral engagement such as task completion rate, number of students completing all tasks, highest student completion rate, number of assignments submitted, number of chapter quizzes completed, number of check-ins, number of daily discussions and number of daily visits for later correlation with teacher support to do correlation analysis and pre- and post-intervention significance tests.

3.3 Research Design

3.3.1 Principles for the design of teacher support strategies

1. Educational perspective - aiding teaching and enhancing the quality of online teaching

The high number of online learning students often leaves students isolated and teachers overwhelmed. Research has shown that students' motivation to engage in educational activities is related to their understanding of the purpose of learning. Letting students understand the teacher's teaching intentions and the way to participate in learning activities can effectively motivate students and guide them to

form good learning behaviors, which in turn can improve the quality of online teaching. The backend analysis technology of the online learning platform can visualize students' behavioral data, and teachers can see the graphs of students' behavioral changes through the platform to provide timely reminders, conduct diagnostics, give encouragement and personalized guidance, and other operations. Therefore, teacher support strategies should be designed to assist teaching and learning, with the ultimate goal of improving education and teaching.

2. Purposeful perspective - optimizing the means and means of teacher support

The design of teacher support strategies from a purposive perspective should be directed at facilitating students' behavioral engagement and optimizing teacher support means and approaches in the process. In this study, two types of teacher support, active and triggered, were designed to target students' learning states for different support strategies. At the same time, behavioral data from the learning platform were used to diagnose whether students' learning behaviors reached the learning target values. When the target value is lower than the target value, the teacher support strategy is triggered to induce changes in students' learning behaviors and change their poor learning behaviors, and to improve and optimize them in the subsequent practice process to enhance students' satisfaction with online teacher support.

3. Reality perspective - the principles of feasibility and achievability

The principle of feasibility: In addition to the learning habits of students formed in the course of daily learning, there are also innate influences that are less likely to change or be influenced, but such behaviors can be improved through long-term systematic training, which is the developmental goal of education, but the design of short-term interventions is not promising in terms of achieving good intervention results. Therefore, the design of teacher support strategies can ignore genetically predetermined learning habits and consider improving learning behaviors that are primarily directed at long-term and short-term environmental formation.

Principle of achievability: the principle of achievability must also be considered when undertaking the design of strategies for teacher support. Design different intervention strategies based on current patterns of learning behaviour and consider

censoring data that cannot be measured and collected through the learning platform.

3.3.2 Six teacher support strategies

The purpose of teacher support for students is to promote independent learning and improve students' emotional regulation, professional skills, and other abilities. Based on the theories and strategy design principles related to teacher support, this study designed six support strategies of diagnosis, explanation, questioning, guidance, encouragement, and criticism and eight teacher support implementation specifics such as organizing learning tasks, recommending reading materials, sending pre-reading texts, and correcting errors in a timely manner from the perspective of promoting behavioral engagement of online students as shown in Table 4.

Table4 Teacher support strategies and implementation components

Support Strategy	Content of implementation	types	Frequency of interventions
Diagnostic Strategies	Designing and organizing learning tasks	proactive	Twice a week
Tip strategy	Recommend reading materials for students and study reminders.	proactive	Four times a week
explanation strategy	Targeted instruction for students	flip-flop (electronics)	Once a day
Guidance Strategy	Send out the pre-reading lesson and guide students to express their opinions.	proactive	Twice a week
Encouragement strategies	Recognize students with long effective learning time and high task completion.	proactive	Once a week.
Critique strategy	Teachers correct mistakes and correct students when they exhibit poor learning behaviors.	flip-flop (electronics)	Once a week.

The teacher support strategy was implemented in a first-year college course of Advanced Mathematics in Qingdao Texas Institute of Technology Vocational College for twelve weeks based on a teacher support schedule, including six weeks of intervention and six weeks of observation. Using behavioral data statistics from the online learning platform and observations of students' behavior by the teaching

assistants, the data were analyzed to test the hypotheses, and analyses of variance and correlation were used to derive the role of the relationship between teacher support and behavioral engagement in learning.

In particular, the diagnostic strategy is implemented by posting learning quizzes every Wednesday and Friday at 8 p.m. The questions on the quizzes are taken from the relevant learning content of the week, and the number of participants, correctness rate, answer time and participation rate are recorded based on the quiz results on the platform. At the end of the quiz, the teaching assistant conducts one-on-one question and answer sessions with the students through the platform in order to keep track of the reasons why the students got the questions wrong and how well they have grasped the learning content. The teacher's prompting strategy is to provide students with learning materials that can help them on a weekly basis, such as explainer videos outside of class, interesting lessons, etc., and to remind students of their learning status when it falls below the set target value. Explanation strategy is to provide targeted answers to students through private messages, forums, etc. to avoid burnout due to the difficulty of learning and the amount of tasks involved. The guidance strategy, on the other hand, is to allow students to effectively streamline their learning and get a quicker understanding of what they are about to learn by posting pre-study lessons. And weekly problem discussions are set up in the forum so that students can discover what is wrong with the program and participate enthusiastically through such small activities to motivate them. The weekly selection of Learning Stars activity is the way to implement the encouragement strategy by selecting the homework stars, discussion stars and visiting stars who are actively involved in learning, offering praise and extra points, thus motivating the students to learn intrinsically. Although this study suggested in the hypothesis that the criticism strategy may have a reverse effect on students' engagement in learning behaviors, it will have different effects for students with different learning styles, appropriate criticism can motivate students to learn, and the criticism strategy is a trigger type strategy that is not triggered when students do not engage in undesirable learning behaviors. Therefore, the criticism strategy was included in the practice strategy, and also to verify whether the criticism strategy

has a reverse facilitating effect on this study setting and group.

The implementation of teacher support strategies requires the recording of the teacher support implementation schedule, which contains eleven data information such as the target of the intervention, time, frequency, type of teacher support, content of the intervention, the problem targeted, the student's response, the student's feedback or effect, and the grade of the effect. The frequency of the intervention was carried out according to the teacher support implementation schedule, according to both trigger and active types, and the actual situation of student learning. In this regard, the grades of effectiveness were classified as effective, average and ineffective.

3.3.3 Implementation of teacher support strategies

The hypothesis of this study is that criticism strategies are negatively related to engagement, persistence, and interaction type of learning behaviors, but there are individual differences and need to be verified through practice, so this study uses criticism strategies according to the actual situation of students' learning.

To ensure the accuracy and scientific validity of the experiment, the same curriculum platform, lesson plans, lesson lengths, lesson difficulty levels, and instructors were used for both the observation and intervention weeks. During the observation week and the intervention week, the teachers taught in the same way as usual, allowing students to learn in their natural state, while during the intervention week, the teacher support strategies were implemented independently by the teaching assistants, who followed up on each student's task completion and provided learning assistance. The teacher support record sheets and implementation schedule were designed based on the instructional calendar and research needs, and some representative continuous teacher support implementation record sheets were selected, as shown in Tables 5 and 6.

Table 5 Record of frequency of interventions for teacher support strategies (partial)

Cycle type		Teacher support strategies					
cyclicality	Intervention time	diagnosis	tuition	prompt	account for	encourage	critique
intervention week	2021/9/15	1	1	1	1	0	0
intervention week	2021/9/16	0	0	1	1	0	0
intervention week	2021/9/17	1	0	1	1	1	0
intervention week	2021/9/18	0	0	0	0	0	0
intervention week	2021/9/19	0	0	0	0	0	0
intervention week	2021/9/20	0	1	0	1	0	0
intervention week	2021/9/21	0	0	1	1	0	0
intervention week	2021/9/22	1	0	0	1	0	0
intervention week	2021/9/23	0	0	1	1	0	1
intervention week	2021/9/24	1	1	0	1	1	0

Table 6 Teacher Support Implementation Record Form (partial)

times	2021/9/15	2021/9/16	2021/9/17
focusing on the problem	Students not completing learning tasks	Promote student-student and teacher-student interaction	Diagnose students' mastery of knowledge points
Target of intervention	Student P, Student Q	Student A	Classes - all members
Support Method	prompt	encourage	diagnosis
Type of support	flip-flop (electronics)	proactive	proactive
Content of the intervention	Post learning reminders	Praise Student A in the discussion forum for helping her classmates with their questions	Post learning quizzes and provide 1-on-1 answers to your classmates
Student response	Student P starts the learning task	Reply to thank the teacher and continue to participate in the inter	19 participants took the learning quiz, 16 got it right, a 68% correct ra

		action	te
Feedback or effects	Increased number of student P visits	Lively participation in the discussion in the days that followed	Students and TAs expressed their appreciation for discussing with each other, and some students missed quizzes and wrote privately to their TAs trying to make up for them
Time for feedback	Student P logs in to the learning platform within 1 hour to participate in the learning	Students log in to the platform within 5 minutes to respond to teacher praise	Learning quizzes are 10 minutes long and students respond positively during 1-on-1 question and answer sessions
Effect Level	effective	effective	effective
instructions	Chapter 1 Learning Tasks	Format control character issues	Examining Point Mode Operations

The Teacher Support Implementation Record Form records a total of six weeks of teacher support for weeks two through seven. The target problem is the occurrence of a problem or the need for help for the student, and the intervention is categorized as to the individual or as a whole. A total of 32 students, 10 males and 22 females, were selected for this study from the Computer 1 class of 2021. The modalities of support were six types of guidance, diagnosis, prompting, explanation, encouragement and criticism and the types of support were trigger and active. The content of the intervention was the specific implementation of the support modalities, such as issuing learning reminders, one-to-one answers and selecting Learning Stars. Also, student responses and feedback or effectiveness of this implementation for students and the timing of the feedback need to be recorded. Effectiveness is graded as effective, fair and ineffective, and the notes or relevant instructions for this implementation are marked in the description column.

In addition, in order to prevent marginal learning behavior of some students, teachers will remind this group of students to actively engage in learning based on the back-end analytics data of the learning platform, which coincides with the original intention of teachers to support prompting strategies. Interactive communication between teachers and students in the online learning environment is extremely important, in order to encourage students to express themselves and actively participate in learning discussions. The author engaged students in reflection

and exploration by setting topics, praising outstanding students for speaking, and motivating other students to think outside the box and showcase themselves. Throughout the teaching process, the teaching assistant creates a positive and enthusiastic learning atmosphere, expresses a strong expectation of student learning success, and works to trigger student motivation and promote good online learning behavior performance through various forms of instructional support.

3.4 Statistics and Data Analysis (Statistics and Data Analysis)

Based on the analytical framework of online learning behavioral inputs and online platform behavioral indicators, three major types of engagement, persistence, and interaction were collected, including total platform visits, daily visits, total number of tasks, average number of tasks completed, task completion rate, number of students completing all tasks, highest number of tasks completed by students, highest rate of tasks completed by students, longest time students watched a learning video, shortest time they watched, average length of video watched, number of chapter quizzes completed, number of assignments submitted, number of daily discussions and number of check-ins, and other twenty-three platform data.

After delineating and defining the online learning behavior input dimensions as well as analyzing their connotations and practicing the platform, seven valid behavior data were retained, namely, the number of discussions on the platform, the number of check-ins, the number of visits to the platform, the number of chapter quizzes posted and assignments completed, the course task completion rate, the highest number of tasks completed by students, and the number of students who unlocked all learning tasks. The learning behavior input data was recorded from week one to week twelve for a cumulative period of twelve weeks beginning on September 7, 2022 and ending on November 27, 2021. Due to the large volume of data, representative raw data and their normalized values were selected for some of the consecutive intervention and observation weeks, and six decimal places were retained in the raw data for scientific accuracy in the data analysis, while only three decimal places were retained in the main text for easier comparison of data as shown in Tables 7 and 8.

Table 7 Behavioural data on students' learning behavioural input measures (partial)

types	subdimensionality	2021/11/1	2021/11/2	2021/11/3	2021/9/15	2021/9/16	2021/9/17
		Week of observation (selected consecutive parts)			Intervention weeks (selected consecutive parts)		
perseve re with	Mission completio n rate	21%	29%	35%	95%	96%	96%
	Completion of all tasksNumber of students	0	0	1	15	17	17
	Highest rate of stu dent completion	86%	93%	100%	100%	100%	100%
particip ate in	Number of assign ments submitted	1	3	0	2	5	8
	Chapter quiz com pletednumber of people	9	12	1	15	17	17
	Number of sign-u ps	31	31	31	32	32	32
	Number of daily d iscussions	2	2	10	9	0	3
interactivit y	Daily visits	114	26	155	280	112	118

Table 8 Normalized values for data on learning behavior input measures (partial)

types	subdimensionality	2021/11/1	2021/11/2	2021/11/3	2021/9/15	2021/9/16	2021/9/17
		Week of observation (selected consecutive parts)			Intervention weeks (selected consecutive parts)		
perse vere wit h	Mission completion rat e	0	0.112	0.187	0.981	0.985	0.995
	Number of students w ho completed all tasks	0	0	0.035	0.535	0.607	0.607
	Highest rate of student completion	0	0.5	1	1	1	1
partici pate in	Number of assignments submitted	0.037	0.111	0	0.064	0.161	0.258

	Number of chapter quizzes completed	0.333	0.444	0.037	0.304	0.391	0.391
	Number of sign-ups	0.968	0.968	0.968	1	1	1
	Number of daily discussions	0.04	0.04	0.2	0.18	0	0.06
interactivity	Daily visits	0.068	0.010	0.096	0.118	0.386	0.134

Learning behavioural inputs include three types of engagement, interaction and persistence. The engagement type includes three behavioral measures: the number of check-ins, the number of visits to the platform, and the number of chapter quizzes and assignments posted for completion. The interaction type includes one behavioral indicator of the amount of discussion on the platform. The persistence type includes three behavioral measures of course task completion rate, the highest number of tasks completed by students, and the number of students who unlocked all learning tasks.

Since the units of each behavioral measure of learning behavior engagement were different, such as the number of check-ins in units of participation type and the number of platform visits in units of number, the data were normalized for different sub-dimensions of the same type, and the analysis of variability before and after the intervention week and observation week of learning behavior engagement was conducted to test the hypotheses. Paired t-tests were used to test whether learning behavior engagement changed after teacher-supported intervention activities, and then correlation analysis was conducted to derive the correlation between teacher support strategies and each type of behavior engagement and its sub-dimensions.

Chapter 4
Data Analysis Result

4.1 Demographic Analysis of The Respondents

The learning behavior input contains three types: interaction, engagement, and persistence, with multiple sub-dimensions under each type. The engagement type includes three sub-dimensions of attendance, time invested, and resource access; the interaction type includes one sub-dimension of amount of discussion; and the persistence type includes three sub-dimensions of task persistence, high engagement retention, and overcoming difficulties. After six weeks of teacher-supported intervention, the results of the pre-post analysis of variability of the data collected under each type and its dimensions are now shown in Tables 9 and 10.

Table 9 T-test results for each type of learning behavior input

paired-sample test	types	average value	(statistics) standard deviation	T-value	df	Sig (bilateral)
Observation week - Intervention week	participate in	-0.663	0.836	-5.323	44	0.000
	interactivity	-6.019	11.051	-3.928	51	0.000
	persevere with	-0.184	0.827	-1.492	44	0.143

Table 10 T-test results for each type of sub-dimension of learning behavior input

paired-sample test	types	subdimensionality	average value	(statistics) standard deviation	T-value	df	Sig (bilateral)
Week of observation - week of intervention	participate in	show up on time for work	0.039	0.202	1.309	44	0.197
		Input time	-0.212	0.299	-4.757	44	0.000
		Resource Access	-0.238	0.386	-4.141	44	0.000
	interactivity	volume of discussion	-6.019	11.051	-3.928	51	0.000
	persevere with	Task adherence	-0.180	0.224	-5.388	44	0.000
		High investment is maintained	-0.046	0.191	-1.815	56	0.075
		overcoming difficulties	-0.031	0.549	-0.430	56	0.669

It can be found that at the 0.001 level, the engagement and interaction types of the learning behavior inputs have significant differences between the intervention week and the observation week, while the persistence type has non-significant differences before and after the intervention. Among them, the sub-dimension of time invested and resource access in the engagement type, the sub-dimension of amount of discussion in the interaction type, and the task persistence dimension in the persistence type had significant differences before and after the intervention, while the sub-dimension of attendance and the sub-dimension of high engagement retention and overcoming difficulties in the persistence type had insignificant differences before and after the intervention. As can be seen, the most significant changes before and after the intervention were in the engagement and interaction types of learning behavior engagement, and the amount of discussion dimension, task persistence dimension, time invested dimension, and resource access dimension had significant changes before and after the intervention, with the intervention week outperforming the observation week and students' online learning behavior engagement significantly improving, as will be analyzed in detail next.

4.1.1 Analysis of the variability of interaction types

The interaction type includes a sub-dimension: the amount of student discussion, where the amount of discussion involves discussion between students and teachers, and discussion between students and students.

The difference between intervention and observation weeks was analyzed by recording the daily discussion volume data from the Umoja learning platform, collating and normalizing them. Using the paired samples t-test of SPSS data processing system, the results showed that students' interaction learning behavior inputs differed significantly between the intervention and observation weeks ($t=-3.928, df=51 p<0.001$). The mean value of the interaction type was -6.019, the standard deviation was 11.051, and the Sig value was 0.000, which shows that the interaction behavior of the students' online learning behavior input was better in the intervention week than in the observation week. During the intervention process combined with real-time observation by the teaching assistants before and after

class, it was found that the number of students asking questions and helping their classmates with their doubts increased significantly during the intervention week, and the teacher support strategy was effective. Students actively interacted with each other through the forum, private messages, and postings on the Umoja learning platform, creating a good dynamic cycle of teacher-student interaction and student-student interaction.

4.1.2 Differential analysis of types of participation

The type of engagement in the learning behavior input includes three sub-dimensions, namely attendance, time invested, and resource access. The attendance corresponds to the number of check-ins for the course, which is expressed as the number of students' learning punch cards. The input time corresponds to the number of students' visits to the platform, and the daily visits to the platform are used to grasp the students' learning engagement status. Resource access corresponds to the number of chapter quizzes and assignments completed and submitted by students.

Differences between intervention and observation weeks were analyzed through SuperStar Learning Connect's engagement behavior data. Using paired samples t-test, the results were obtained showing that the type of engagement learning behavior input of students differed significantly between intervention and observation weeks ($t=-5.323$, $df=44$, $p<0.001$), a mean value of -0.663, standard deviation of 0.836 and Sig two-sided value of 0.000.After further analysis, it was found that the time dimension of input, i.e., daily visits, differed between intervention and observation weeks The resource access dimension, i.e., students' completion and submission of chapter quizzes and assignments, also differed significantly between the intervention and observation weeks ($t=-4.141$, $df=44$, $p<0.001$), with a mean value of -0.212, standard deviation of 0.299, and Sig two-sided value of 0.000. The mean value was -0.238, standard deviation was 0.386, and sig two-sided value was 0.000. while the attendance dimension, i.e., the number of students signing in for the course ($t=1.309$, $df=44$, $p>0.001$), did not differ significantly between the intervention and observation weeks, with a mean value of 0.039, standard deviation

of 0.202, and sig two-sided value of 0.197, indicating that teacher support had an insignificant effect on students' Attendance dimension did not have a significant effect or that the number of classes students clocked was not associated with the availability of teacher support.

The experimental data revealed that the type of engagement in students' online learning behavioral inputs changed significantly before and after the intervention, with significant differences before and after. Each of the three dimensions of engagement type, attendance, time invested, and resource access, differed, with the attendance dimension not significantly affected by the pre- and post-intervention, while the time invested and resource access dimensions both had significant changes before and after the intervention, with students' time invested and resource access significantly better in the intervention week than in the observation week.

In addition to the validation based on the experimental data, during the experiment the author found that the teacher support strategy was particularly effective in boosting student access, with a surge in student learning access during the intervention week and a significant increase in the number of student visits to various resources. Also, there was a significant increase in the number of assignments submitted and chapter quizzes completed by students during the intervention cycle, while there was no significant difference in the number of students clocking in and out of their learning sessions, which tended to stabilize.

4.1.3 Differential analysis of adherence types

The persistence type of learning behavior engagement contains three sub-dimensions, namely task persistence, high engagement retention, and overcoming difficulties. Task persistence corresponds to a measure of the course's task completion rate, which is the ratio of the average number of tasks completed by students to the total number of tasks issued by the instructor. High engagement retention corresponds to the highest number of tasks completed by students, and students' high engagement retention status is determined by observing the highest number of tasks currently completed by students. Overcoming difficulties

corresponds to the platform measure of the number of students completing all learning tasks, and all learning tasks include tasks such as learning videos and courseware.

Comparing the persistence behavior learning data between the intervention week and the observation week through the behavioral data from the Umoja learning platform revealed a non-significant pre-post variability (t=-1.492, df=44, p>0.001)) with a mean of -0.184, standard deviation of 0.827, and Sig biserial value of 0.143, but the overall intervention week effect was better than the observation week. Upon further analysis, it was found that while the overall data for persistence behavior did not differ significantly between intervention and observation weeks, the task persistence dimension, i.e., task completion rate of the course, differed significantly between intervention and observation weeks ($t = -5.388$, $df = 44$, $p < 0.001$)) with a mean of -0.180, standard deviation of 0.224, and Sig two-sided value of 0.000. high engagement retention dimension, i.e., the highest number of tasks completed by students, was not significantly different between intervention and observation weeks ($t = -1.815$, $df = 56$, $p > 0.001$), with a mean value of -0.046, a standard deviation of 0.191, and a Sig two-sided value of 0.075, but the highest number of tasks completed by students was higher overall in intervention weeks than in observation weeks. The number of students overcoming the difficulty dimension, i.e., currently unlocking all learning tasks, was not significantly different between intervention and observation weeks ($t = -0.430$, $df = 56$, $p > 0.001$)), with a mean of -0.031, standard deviation of 0.549, and Sig two-sided value of 0.669, but the number of students completing all tasks was overall higher in intervention weeks than in observation weeks.

In summary, the results showed that there was no significant difference in the type of persistence in students' behavioral engagement in online learning before and after the intervention, but that students' persistence was better in the intervention week than in the observation week. In particular, the task persistence dimension of the persistence type was significantly different before and after the intervention, and the high engagement retention and overcoming difficulties dimensions were not significantly different before and after the intervention, but

were better in the intervention week than in the observation week.

In addition to the validation of the data results, the effect of teacher support strategies on students' overall task completion rates was found to be significant during the course of the experiment. During the intervention cycle, students' average task completion rate was on the high side, with a mean value of over 90%, while the average task completion rate of students during the observation cycle converged roughly to 80%. The highest number of tasks completed by students, on the other hand, was almost taken up by the active members within the class in both the intervention and observation weeks, and the effect of the intervention strategy was not significant. The number of students completing all learning tasks was also not significantly influenced by teacher support, but the number of completions during the intervention cycle was still slightly higher than during the observation week.

From this, it can be seen that after six weeks of the teacher support intervention, there was a significant increase in student interaction behaviors such as the number of teacher-student and student-student discussions, a similar increase in student time commitment dimensions such as student daily visits, and a significant increase in student resource access such as assignment and chapter quiz submissions. There was also a significant increase in students' task adherence dimension i.e. average completion rate in the intervention week compared to the observation week. Whereas, students' attendance dimensions i.e. number of course check-ins, high engagement retention dimension and overcoming difficulties dimension were not significantly different between the intervention and observation weeks and the effectiveness of the support strategies on them was low and will be improved and enhanced in the subsequent study.

4.2 Effects of teacher support strategies on behavioral engagement in learning

A total of six teacher support strategies of diagnosis, prompting, instruction, explanation, encouragement, and criticism were implemented in this study during the intervention, and t-tests revealed significant differences in the types of

interaction and engagement in students' behavioral engagement in online learning, as well as in the four dimensions of time invested, resource access, amount of discussion, and task adherence before and after the intervention. Although other influencing factors were controlled for, it was not possible to ensure whether changes in behavioral engagement were influenced by individual differences in students' own moods and states. Therefore, the correlations between the six strategies of teacher diagnosis, explanation, instruction, prompting, encouragement, and criticism and the three types of engagement and the four sub-dimensions were analyzed to test for significant correlations as a way to determine the relevant effects of teacher support strategies on behavioral engagement in learning. Since the implementation of teacher support strategies was based on frequency statistics and the types of learning behavior inputs and the indicators of each dimension were not uniform, the data of teacher support and each data of learning behavior inputs were still normalized and the values of the dimensions were measured uniformly. The results of the correlation analysis of each type and its sub-dimensions with teacher support strategies are shown in Tables 11 and 12.

Table 11 Results of the correlation analysis between the three types of behavioral inputs and teacher support

kindtype (e.g. blood type)		account forstrategy	tuitionstrategy	promptstrategy	diagnosisstrategy	encouragestrategy	critiquestrategy
participate in	Pearson correlation	0.608**	0.376*	0.092	0.171	0.105	0.099
	Significance (bilateral)	0.000	0.011	0.547	0.263	0.492	0.518
	N	45	45	45	45	45	45
interactivity	Pearson correlation	0.273	0.412**	0.379*	0.087	0.416**	-0.177
	Significance (bilateral)	0.069	0.005	0.010	0.572	0.004	0.444
	N	45	45	45	45	45	45
persevere with	Pearson correlation	0.333*	0.584**	0.134	-0.083	-0.008	0.035
	Significance (bilateral)	0.025	0.000	0.380	0.588	0.961	0.817
	N	45	45	45	45	45	45

Table 12 Results of the correlation analysis between the four sub-dimensions of learning behavior engagement and teacher support strategies

types	subdimensionality		explanation strategy	Guidance Strategies	Tip strategy	Diagnostic Strategies	Encouragement strategies	Critique strategy
participate in	investment time	Pearson correlation	0.315*	0.369*	-0.172	0.061	0.031	-0.103
		Significance (bilateral)	0.035	0.013	0.258	0.691	0.839	0.503
		N	45	45	45	45	45	45
	Resource Access	Pearson correlation	0.623**	0.369*	0.128	0.107	0.054	0.166
		Significance (bilateral)	0.000	0.013	0.401	0.483	0.726	0.276
		N	45	45	45	45	45	45
interactivity	volume of discussion	Pearson correlation	0.273	0.412**	0.379*	0.087	0.416**	-0.177
		Significance (bilateral)	0.069	0.005	0.010	0.572	0.004	0.444
		N	45	45	45	45	45	45
persevere with	Task adherence	Pearson correlation	0.333*	0.584**	0.134	-0.083	-0.008	0.035
		Significance (bilateral)	0.025	0.000	0.380	0.588	0.961	0.817
		N	45	45	45	45	45	45

In summary, it can be seen that teachers' explanatory strategies were significantly related to engagement and persistence types of learning behavior engagement, teachers' instructional strategies were significantly related to engagement, persistence, and interaction types of learning behavior engagement, teachers' prompting and encouragement strategies were significantly related to interaction types of learning behavior engagement, and teachers' diagnostic and criticism strategies were not statistically significant with learning behavior engagement. Overall, teachers' explanatory, instructional, encouragement, and prompting strategies had a significant effect on students' engagement in online learning behaviors, while diagnostic and criticism strategies had a non-significant effect. The analysis of teacher support strategies in relation to each sub-dimension of engagement, persistence and interaction will be described in detail later.

4.2.1 The effect of teacher support strategies on the type of participation

A total of six teacher support strategies were implemented with students during the intervention week: diagnosis, explanation, prompting, guidance, encouragement, and criticism, which were categorized as proactive and triggered. Interventions were designed and delivered according to the behavioral problems reflected by the students, and the frequency of interventions was adjusted according to the specific situation, and the feedback and status of the students and the time of feedback were recorded to determine the effectiveness level of the interventions, which were classified as effective, average and ineffective.

Pearson correlation analysis of the six teacher support strategies and types of engagement revealed a significant correlation between teachers' explanatory strategies and types of engagement in students' learning behavior inputs (r=0.608, Sig=0.000, N=45). In addition, the teacher's instructional strategy and the type of engagement in the student's learning behavior input (r=0.376, Sig=0.011, N=45) was significantly correlated. Teachers' encouragement strategies and students' type of engagement (r=0.105, Sig=0.492, N=45) were not correlated. The results of the correlation coefficient between teachers' critique strategies and students' types of engagement were (r=0.099, Sig=0.518, N=45), teachers' prompting strategies and students' types of engagement. The correlation coefficient results were (r=0.092, Sig=0.547, N=45)) and the correlation coefficient between the teacher's diagnostic strategy and the type of student engagement was (r=1.171, Sig=0.263, N=45).

Therefore, it can be concluded that there is a significant correlation between the teacher's instructional and explanatory strategies and the type of engagement in the students' behavioral inputs to learning, and the effects on the students' engagement behaviors are, in order of strength of influence, explanatory, instructional, diagnostic, encouraging, critical, and prompting strategies.

The types of student behavioral engagement included the attendance dimension, resource access dimension, and time commitment dimension. Because the attendance dimension, i.e., the number of check-ins for the course, did not differ significantly before and after the intervention, no correlation analysis was conducted.

For the resource access and input access dimensions, the six support strategies had the following correlational effects on the two: there was a significant correlation between the student's explanation strategy and the input time dimension of the type of engagement, i.e., the student's daily visits (r=0.315, Sig=0.035, N=45). There was a significant correlation between students' instructional strategies and the input time dimension of engagement type i.e. students' daily visits (r=369, Sig=0.013, N=45). The correlation coefficient between students' encouragement strategies and the input time dimension of the type of engagement i.e., students' daily visits was (r=0.031, Sig=0.839, N=45), the correlation coefficient between students' criticism strategies and the input time dimension of the type of engagement i.e., students' daily visits was (r=-0.103 , Sig=0.053, N=45), and the correlation between students' prompting strategies and the (r=-0.172, Sig=0.258, N=45) for the input time dimension of type i.e. students' daily visits and (r=0.061, Sig=0.691, N=45) for the input time dimension of students' diagnostic strategies and engagement type i.e. students' daily visits.

Thus, it can be seen that in terms of the dimension of time invested, there is a significant correlation between teachers' instructional and explanatory strategies and daily visits, and the effects on daily visits are, in order of strength, instructional, explanatory, prompting, criticism, diagnostic, and encouragement strategies, with criticism and prompting strategies having a negative effect on the dimension of daily visits.

Secondly, the correlations between various teacher support strategies and resource access dimensions i.e. assignment, chapter quiz submission and completion were as follows: there was a significant correlation between students' explanation strategies and the resource access dimension of students' learning behavior inputs (r=0.623, Sig=0.000, N=45). The correlation coefficient between students' encouragement strategies and the resource access dimension of learning behavior input was (r=0.054, Sig=0.726, N=45), the correlation coefficient between students' criticism strategies and the resource access dimension of learning behavior input was (r=0.166, Sig=0.276, N=45), the correlation coefficient between students' prompting strategies and the resource access dimension of learning behavior input

was correlation coefficient was (r=0.128, Sig=0.401, N=45), the correlation coefficient for the resource access dimension of students' diagnostic strategies and learning behavior inputs was (r=0.107 , Sig=0.483, N=45), and the correlation coefficient for the resource access dimension of students' instructional strategies and learning behavior inputs was (r=0.238, Sig=0.115,. N=45). In summary, for the resource access dimension in the type of engagement, there was a significant correlation between teachers' explanatory strategies, in order of strength of influence, and explanatory, instructional, critical, prompting, diagnostic, and encouraging strategies, all of which positively influenced them.

In summary, teachers' explanatory strategies were significantly correlated to the type of engagement and were significantly correlated to the input time dimension and the resource access dimension in the type of engagement. There is a significant correlation between teachers' instructional strategies on the type of participation and on the input time dimension and resource access dimension in the type of participation.

4.2.2 The effect of teacher support strategies on the type of interaction

Interaction refers to students' communication with teachers and peers through forums and postings on the Umoja learning platform. This input type contains one dimension i.e. the amount of discussion between teachers and students and students. Pearson correlation analysis of the six teacher support strategies and interaction types showed that there was a significant correlation between teacher's encouragement strategies and students' learning behavior input in the interaction type (r=0.416, Sig=0.004, N=45). There was a significant correlation between the teacher's prompting strategy and the type of interaction in the student's learned behavior input (r=0.379, Sig=0.010, N=45), and there was a significant correlation between the teacher's instructional strategy and the type of interaction in the student's learned behavior input (r=0.412, Sig=0.005, N=45). The correlation coefficient between the teacher's explanation strategy and the type of interaction in the learning behavior input was (r=0.273, Sig=0.069, N=45), the correlation coefficient between the teacher's critique strategy and the type of interaction in the

learning behavior input was (r=-0.117, Sig=0.444, N=45), and the correlation coefficient between the teacher's diagnosis strategy and the type of interaction in the learning behavior input for (r=0.087, Sig=0.572, N=45).

In summary, it can be seen the degree of correlation between the six teacher support strategies and the type of interaction in the learning behavior input, i.e., the amount of student access, with a significant correlation between three strategies of teacher's guidance, prompting and encouragement strategies and the type of interaction and its sub-dimension of discussion. For the other support strategies in order of strength of influence are encouragement, guidance, prompting, explanation, criticism and diagnosis strategies, where criticism strategy and the type of interaction of the students are negatively influenced and the rest are positively influenced.

4.2.3 The effect of teacher support strategies on adherence type

Persistence refers to the degree of effort students can make to solve problems when they encounter difficulties and pressure in the online learning process, including the three dimensions of students overcoming difficulties, persisting in completing learning tasks, and maintaining high engagement in learning. The platform indicator corresponding to the overcoming difficulties dimension is the number of students who unlock all learning tasks, the platform indicator corresponding to the high engagement retention dimension is the highest number of tasks completed by students, and the platform indicator corresponding to the task persistence dimension is the course task completion rate.

Pearson correlations were conducted for the six support strategies and persistence types, and students' behavioral engagement persistence types included three sub-dimensions: the task persistence dimension, the overcoming difficulties dimension, and the high engagement retention dimension. Because the difference between the overcoming difficulties dimension, i.e., the number of students who unlocked all learning tasks, and the high engagement retention dimension, i.e., the highest number of tasks completed by students, was not significant before and after the intervention, no correlation analysis was conducted. For the task persistence dimension, i.e., the average rate of task completion by students, the six support

strategies were correlated as follows: there was a significant correlation between the teacher's instructional strategy and task persistence in students' learning behavior inputs (r=0.584, Sig=0.000, N=45) and a significant correlation between the teacher's explanatory strategy and the task persistence dimension in students' learning behavior inputs (r=0.342, Sig= 0.022, N=45) were significantly correlated. In addition, the correlation coefficient between teachers' encouragement strategies and students' task persistence dimension was (r=-0.008, Sig=0.961, N=45), the correlation coefficient result between teachers' criticism strategies and students' task persistence dimension was (r=0.035, Sig=0.817, N=45), and the correlation coefficient result between teachers' prompting strategies and students' task persistence dimension was (r= 0.134, Sig=0.380, N=45), and the correlation coefficient between the teacher's diagnostic strategy and the student's task persistence dimension was (r=-0.083, Sig=0.588, N=45). It can be seen that the support provided through the teacher at the time of the intervention week led to an effective increase in the students' task completion rate on the platform. It has been proven that teachers providing effective support strategies not only promote students' behavioral engagement but also increase students' learning persistence.

Therefore, it can be concluded that there is a significant correlation between the teacher's instructional and explanatory strategies and the type of engagement in online learning behavior inputs, where there is a significant correlation between the teacher's instructional and explanatory strategies and the task persistence dimension in students' learning behavior inputs. The effects of other support strategies on the task persistence dimension of students' persistence behaviors were, in order of strength, instructional, explanatory, prompting, diagnostic, critical, and encouragement strategies, with encouragement and diagnostic strategies having a negative effect and the rest having a positive effect.

4.3 Discussion and recommendations

4.3.1 Teacher support has a positive impact on promoting students' engagement in online learning behaviours

After a series of analyses of the design of teacher support strategies, the

construction of an analytical framework and measures of learning behavior engagement, the implementation of a quasi-experimental study, and statistical data. It was found that for the three types of learning behavior engagement: interaction, participation, and persistence, the interaction type and participation type differed significantly between the intervention and observation weeks of the experiment, with the overall effect of the intervention week being better than the observation week. Whereas the persistence type did not differ significantly between the intervention and observation weeks, the task persistence dimension of the persistence type also had a positive impact on the impact of teacher support. Combining the definitions of the three types and the connotations of behavioral engagement in learning reveals that teacher support has a slightly lower impact on students' deep persistence than short-term effective learning, but the intervention week is still better than the observation week. The indication of the data through twelve weeks of instructional practice suggests that teacher support has a positive impact on promoting students' behavioral engagement in online learning.

Therefore, when teachers implement instruction through the online platform, they can use the four support strategies designed in this study: instruction, explanation, prompting, and encouragement to promote students' behavioral engagement in learning, and the instructional support and strategies that need to be employed for students to sustain a deep state of retention should be optimized and improved for the design of teacher support strategies in subsequent studies.

4.3.2 Teacher support strategies can serve as a guide for students to form good study habits

The paired t-test results showed that the engagement type's input time i.e., visits, resource access i.e., completion and submission of assignments and chapter quizzes were significantly different before and after the intervention, while the attendance dimension i.e., the number of students who signed in and clocked out were not significantly different before and after the intervention. Also, the task persistence dimension of the persistence type i.e. the average task completion rate of students was significantly different between intervention and non-intervention weeks, while

the high engagement retention dimension and overcoming difficulties dimension were not significantly different before and after the intervention, and the amount of discussion dimension of the interaction type was significantly different before and after the intervention.

Therefore, it can be seen that the presence of teacher support plays a crucial role in guiding these study habits that are extremely easy to develop, such as guiding students to use learning resources wisely, following the dynamics of the learning platform, and participating more in learning communication and exchange. For more stable learning habits that students have formed over the years, such as signing in and punching cards and completing learning tasks assigned by the teacher first, the effect of teacher support strategies is weaker. In the teaching process teachers can provide interesting resources, engaging learning topics and post learning reminders as a way to wind up students' learning behavior and study habits. Teachers who teach online can refer to the use of strategies of instruction, explanation, prompting and encouragement to promote students' engagement behaviors such as participating in interactions and submitting assignments. In addition to this, when designing teacher support strategies it is important to consider not only the feasibility but also the means that can be used to effectively improve students' poor learning habits, behaviors and thus form good learning behaviors.

4.3.3 Professional support from teachers is more effective than emotional support

After the results of the pre- and post-intervention variance analyses could be carried out to further explore the specific effect of the six teacher support strategies on engagement in learning behaviors. Therefore, Pearson correlation analysis was used to correlate the types and their sub-dimensions with the six teacher support strategies, and the results for the types of engagement were found to show significant correlations between teachers' instructional and explanatory strategies and the types of engagement in students' engagement in learning behaviors. The effects on students' engagement types, in order of strength of influence, were explanatory, instructional, diagnostic, encouraging, critical, and prompting strategies. For the dimension of time invested in the type of engagement, there was a

significant correlation between teachers' instructional and explanatory strategies and daily visits, with the degree of impact on daily visits being, in order of strength, instructional, explanatory, prompting, critical, diagnostic, and encouraging strategies, with critical and prompting strategies having a negative impact on daily visits. For the resource access dimension in the type of engagement, there was a significant correlation between teachers' explanatory strategies and, in order of strength of effect, explanatory, instructional, criticism, prompting, diagnostic, and encouragement strategies, with all strategies having a positive effect.

The analysis of the data results for the engagement type shows that the instructor's guidance and explanation strategies have a significant boost on the time and depth of students' investment in accessing the online learning system and course knowledge points and resources, and for the interaction type, the instructor's prompting and guidance strategies are equally effective on students' discussion volume dimension. Comparing the results of the correlation analysis of the three types of learning behavior engagement, it can be found that the guidance, prompting and explanation strategies in the teacher's professional support have a significant positive contribution to students' learning behavior engagement, while the encouragement strategy in the emotional support only has a positive contribution to students' interaction type, and the criticism strategy basically shows a negative effect on each dimension. Therefore, professional support tools such as teacher guidance and explanation can be added during teaching practice to promote the level of student engagement in course knowledge points, resource access, etc.

4.3.4 Teachers' critical strategies can reduce students' engagement in interactions

In terms of the type of interaction, the results showed that the correlation between the six support strategies and the type of interaction in the learning behavior input, i.e., student access, in order of the strength of influence, were encouragement, instruction, prompting, explanation, criticism, and diagnostic strategies. Among them, criticism strategies and students' interaction behaviors were negatively influenced, while the rest were positively facilitated. By looking at the

results of the data, it can be found that teachers' encouragement, prompting and instructional means can promote students' interaction behaviors, and teachers' criticism has a reverse effect on students' interaction inputs. In addition, the use of critical strategies did not have a positive effect on students' behavioral engagement in all dimensions, thus validating the hypothesis of this study on the relationship between critical strategies and behavioral engagement in learning. Therefore, teachers should try to use less criticism to communicate with students in the teaching process, and should encourage more, provide more professional guidance to students and use more gentle supervision such as learning prompts to get students to join the learning and discussion team.

Chapter 5
Conclusions and Discussion

5.1 Summary of the study

5.1.1 Timely guidance and support can be effective in promoting student engagement in online learning

In the process of online learning, students' learning behavioral inputs are the most visually evident behaviors, with engagement behaviors being the most directly observable and fundamental learning behaviors; if students are not engaged in the learning process, the online course is meaningless. It has been shown that behavioral engagement predicts and influences cognitive engagement and affective engagement. Therefore, the primary thing that should be done with regard to students' learning behavioral engagement is to increase student engagement in online learning courses.

In a traditional classroom setting, teachers teach face-to-face with students, and teacher support behaviors such as interaction, reminders, and instruction are much easier to implement. In the online environment, the large volume of students and the inability to perform batch operations make it easy for teachers to overlook their own instructional support role for students and to confuse it with the traditional teaching model by failing to provide targeted instructional support, thus potentially resulting in ineffective support, etc. However, based on existing online learning platforms and learning analytics technology can greatly simplify the steps and means for teachers to provide support, and for teachers to realize the importance of teacher support has a profound impact on enhancing student engagement and motivation in online learning.

This study designed six teacher support strategies based on support theory and the perspective of promoting behavioral engagement. After the experimental study, it was found that the engagement types of students' behavioral engagement in learning were significantly different before and after the intervention, that students' perceived teacher support in online learning environments could influence their behavioral engagement in learning, and that there was a significant positive

correlation between teachers' explanatory and instructional strategies on students' behavioral engagement in learning. Teachers' professional support for students is effective in promoting students' engagement in online learning, which also coincides with the hypothesis of this study that teacher support can positively influence the type of engagement in online learning behavioral engagement. The experimental data showed significant differences in the types of engagement before and after the intervention, and the research hypothesis held true. Thus, teachers who teach online can use their expertise to help students solve problems and engage in learning in a timely manner.

5.1.2 Communication and exchange is a key step in opening the window to student learning

Students engage in learning with a variety of problems, and the first step in solving them is communication and interaction. Many students have problems but are not willing to communicate with the teacher, preferring to seek solutions on their own or give up. Therefore, I designed the teacher support strategy with student psychology in mind and designed a weekly theme-posted teaching activity to provoke students to join the discussion. Students are provided with some entertaining online teaching videos such as "Second to Know" to stimulate their interest in learning. We also set up a weekly "Learning Star" contest to encourage the students who help students with the most questions and the students with the highest number of discussions each week to be awarded the honorary title of Learning Star, which is very effective. The number of discussions, private messages and interactions among students has increased significantly.

The results of the experimental data also provide ample evidence that the types of interactions in learning behavioral engagement differ significantly before and after the intervention, that students' perceived teacher support can influence their learning behavioral engagement, and that there is a significant positive correlation between teachers' guidance, prompting, and encouragement strategies on the amount of discussion dimension of students' interaction types. The validation of the practice data and the accompanying observations of the teaching assistants can

fully verify that teacher support strategies such as providing guidance, encouragement, and prompts by teachers can open the window of student learning and make students willing to actively communicate and interact and engage in discussions, thus producing better learning outcomes and enhancing the quality of online learning. The results of the experimental data also verified that teacher support can positively contribute to the types of interactions in students' behavioral inputs to online learning, and the hypothesis held true with significant differences in the types of interactions before and after the intervention. Therefore, teachers of online teaching can completely abandon the distance gap between the online platform and students and fully utilize the inherent emotional connection between teachers and students to provide professional guidance, learning tips, and emotional encouragement to student pairs, enhance communication, and engage in two-way interactions with students. Students are allowed to open up their inner knowledge outlets and are willing to give feedback to the teacher on their doubts and unanswered questions so that the problems can be solved.

5.1.3 Teacher support can be effective in promoting ongoing student learning

Whether it is online learning or face-to-face lectures or even blended learning mode, students actively participate in the course and form a good interaction with the instructor, the last thing we hope to achieve is the students' love for the course and learning persistence. What we hope to achieve is a sustained, good learning habit, interest in learning and intrinsic motivation to learn.

The types of persistence in students' behavioral engagement were divided into three dimensions: task persistence, high engagement retention, and overcoming difficulties, with task persistence focusing on the average task completion rate of students in the class and targeting the entire learning population. The results of the data from the study indicated that while the type of persistence did not differ significantly before and after the intervention, one of the task persistence dimensions differed significantly before and after the intervention, and there was a significant correlation between teacher explanation and instructional strategies on

the average task completion rate of students, meaning that providing professional explanation and instruction by the teacher was effective in increasing the overall class's completion of the task. Keeping students consistently, diligently and actively engaged in learning is an achievable and attainable instructional goal. This could also answer the research question posed in this study that teacher support can positively impact the type of persistence in behavioral engagement in online learning, with a significant difference in the type of persistence before and after the intervention, and the research hypothesis holds true. The dimensions of high engagement retention and overcoming difficulties will also be improved in subsequent studies in order to achieve a good state of online learning with active student participation, two-way interaction and sustained persistence.

The results of the analysis and validation of the collected online learning behavioral inputs through a twelve-week teaching practice indicate that students' perceived instructor support in online learning environments can have an impact on learning behavioral inputs. Also, teacher support has a significant impact on the type of engagement and interaction in online learning behavior inputs. Hypotheses H1 and H2 hold, and hypotheses H5, H7, and H9 hold. For hypotheses H4, H6, and H8, there is a positive correlation between teachers' explanatory and instructional strategies for engagement type, positive correlation between teachers' instructional, prompting, and encouraging strategies for interaction type, and positive correlation between teachers' instructional and explanatory strategies for task persistence dimension in persistence type. In subsequent research, the author will continue this study to deepen the exploration of learning behavior engagement in online learning environments and to optimize the design and implementation process of teacher support strategies.

5.2 Research gaps and outlook

Based on the theoretical foundations, theories and principles related to teacher support and learning behavior input, the study designed an analytical framework for teacher support strategies and defining learning behavior input, conducted a quasi-experimental study, applied a theory-in-practice approach, and upheld

scientific and objective teaching principles to complete the design, practice, and analysis process of this dissertation. However, due to the lack and limitation of my research capacity and research environment, this study has several shortcomings and limitations as follows.

Consistency testing was not conducted in the delineation and coding of the dimensions of teacher support and was subjective; if there is sufficient time, the author will follow up with the research team to conduct consistency testing of teacher support. Second, the strategy design of teacher support did not adequately take into account the difficulty of changing the persistence dimension, resulting in less than satisfactory results of the experiment. There are many shortcomings and imperfections in the design and implementation of the experiment. And due to the limitations of the experimental platform, only three dimensional changes in learning behavioral engagement could be observed. The author will continue to enrich and complete the inquiry of teacher support on learning behavior input in other studies in the future. This study is only a preliminary exploration of the role relationship between teacher support and learning behavior input in online learning environment, in order to provide scientific optimization strategies and improvement paths for online teaching practice.

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