

Article

The Positive Effects of Growth Mindset on Students' Intention toward Self-Regulated Learning during the COVID-19 Pandemic: A PLS-SEM Approach

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Abstract: The COVID-19 pandemic has brought unprecedented challenges to students' learning processes in higher education. This study aimed to investigate the effects of a growth mindset on university students' intention toward self-regulated learning during the COVID-19 pandemic. The theoretical model was proposed based on the Theory of Planned Behavior, along with two additional dimensions: growth mindset and perceived teacher support. The developed model was validated by adopting a partial least squares structural equation modeling (PLS-SEM) approach based on the data collected from 486 students in universities that have been significantly impacted by the COVID-19 pandemic in China. The results show that students' growth mindset is positively associated with their intention toward self-regulated learning directly, and indirectly through the main constructs of the Theory of Planned Behavior: perceived behavioral control and behavior attitude. Additionally, the mediating and moderating roles of students' growth mindset are manifest in the relationship between students' perception of teacher support and their intention toward self-regulated learning. These findings offer implications for teachers, researchers, and higher education administrators in developing students' growth mindset by considering the relevant factors explored in this research, thereby enhancing students' self-regulated learning in challenging settings such as the COVID-19 pandemic.

Keywords: growth mindset; perceived teacher support; self-regulated learning; theory of planned behavior; partial least squares structural equation modeling (PLS-SEM); COVID-19



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1. Introduction

Currently, the COVID-19 pandemic has been exerting an undesirable influence on educational activities in universities across China because of lockdowns or physical distancing policies implemented by local governments, resulting in the deprivation of traditional learning methods for college students [1]. Under such challenging conditions, students need to take more responsibility for their own learning, and, consequently, self-regulated learning has become an indispensable activity, in which students need to plan their learning process, schedule learning goals, and then apply personal learning strategies so as to achieve better learning outcomes [2–4]. Both educators and researchers have focused on the positive roles of students' personal psychological characteristics such as growth mindset on their learning process [5–7]. The concept of a positive mindset, or a growth mindset, was proposed as part of the Mindset Theory, or the Implicit Theory of Intelligence [8], in

which intelligence is thought to be malleable in individuals with a growth mindset [9]. As an intra-individual characteristic, a growth mindset has been shown to have a positive effect on learning motivation and resilience to stress for individuals who face challenges during the learning process [10]. This is because students who have a growth mindset regularly set goals to achieve and do not find quitting easy when they encounter difficulties in learning [9,11]. During the process of self-regulated learning in the setting of the COVID-19 pandemic, students should set their learning goals and apply their learning strategies through monitoring, regulating, and controlling themselves [12]. Their intention to engage in self-regulated learning may vary depending on a number of factors, so their learning presents different outcomes for different students [3]. During the COVID-19 pandemic era, students' intention toward self-regulated learning is essential for their academic success as there is less supervision by teachers than would be the case for face-to-face instruction in a classroom. Viewed as a strong predictor of learning motivation or intention [10], students' growth mindset might be playing a big role in students' self-regulated learning during the current pandemic as well. Thus, one big concern to be addressed is the question of through which pathways and to what degree students' growth mindset is associated with their intention toward self-regulated learning in the context of the COVID-19 pandemic. According to the Theory of Planned Behavior, an individual's intention toward a certain behavior can be determined by factors such as the person's attitude toward the behavior (behavior attitude), the pressures or influences from the people around them (subjective norms), and the person's belief in their ability to manage or control the situation (perceived behavioral control) [13]. The model of this theory has been adopted in a range of prior studies to explain factors related to learning behaviors [3,14–16]. Thus, it is advisable to validate the effectiveness of a growth mindset in promoting students' intention toward self-regulated learning through the pathway of constructs in the Theory of Planned Behavior, and hopefully doing so will bring some contributions for understanding learners' growth mindset and improving students' learning during the pandemic era.

Moreover, students' growth mindset is related to the assistance they receive from the people they regularly interact with, and that can thus be considered to be a contextual factor for developing their intelligence or ability [17]. During the current COVID-19 pandemic, support from teachers builds a safe learning environment for students, even though this does not take place through face-to-face interaction [6]. Instead, students can obtain important information or messages from teachers through online interactions [18] and thereby perceive teachers' support for their learning [19–21]. Skinner and Belmont [22] once claimed that students' perception of teacher support is interrelated with their behavioral intention of learning. Thus, there is an association between students' growth mindset, perceived support from teachers, and their intention toward learning behaviors, with no exception for self-regulated learning under the current COVID-19 pandemic.

There have been numerous prior studies on the association between a growth mindset and students' learning behavior [11,23,24], while less research has studied the role of students' growth mindset in learning during the COVID-19 pandemic based on an extended model of the Planned Behavior Theory. Starting from this model and based on previous research, we explored the influence of students' growth mindset on their intention toward self-regulated learning. The major aims and objectives of the research are to assess the positive effects of a growth mindset on students' intention toward self-regulated learning directly, and indirectly through the constructs of the Theory of Planned Behavior (perceived behavioral control, behavior attitude), and to study the mediating and moderating roles of a growth mindset in the relationship between perceived teacher support and students' intention toward self-regulated learning. The ultimate purpose of this study is to broaden the research and enrich the literature on the growth mindset, and to provide practical implications for improving students' growth mindset, thereby enhancing students' learning, especially in challenging settings such as the COVID-19 pandemic. The rest of the article is structured as follows. The next section reviews the literature and proposes the research hypotheses. The subsequent section highlights the methodology used in the study. The

results of the study are then presented and discussed. Finally, the implications of the study are provided, and some conclusions are made.

2. Literature Review and Hypotheses

2.1. Growth Mindset

The Mindset Theory originated from the Implicit Theory of Intelligence, and it indicates that an individual either embraces a mindset of fixed and stable intelligence, or one of unfixed and changeable intelligence [8,9]. The concept of the growth mindset then began to develop with the release of the book by Dweck [25], *Mindset: The New Psychology of Success*. Specifically, a growth mindset is described as “a person’s belief that intelligence or abilities are easily influenced and can be developed through hard work, good strategies, and instruction from others” [11] (p. 1849). A growth mindset has been confirmed to be both a persuasive psychological characteristic and an intra-individual characteristic of individuals [9].

A growth mindset can produce abundant positive outcomes, especially in educational contexts [26]. Learners with a growth mindset usually optimize their learning goals, consider the effort of learning to be rewarding, and see challenges or difficulties as part of the learning process [11,23]. They actively engage in or expect more from learning [27,28], and set objectives for mastering certain knowledge or skills [23]. People with a growth mindset exhibit increased persistence in learning [24], and actively involve themselves in difficult learning tasks [29]. A growth mindset has also been confirmed to be an indicator of greater academic achievements [23,29] and higher scores on standardized exams [24].

Some policy recommendations for educational institutions have been proposed for altering students’ mindsets through the practice of interventions, hoping to help them achieve anticipated outcomes [30]. More inspiringly, students with special needs or those with initially low levels of achievements were likely to derive substantial benefits from growth mindset interventions, as they were gradually motivated in a positive way and made to feel more resilient when facing academic failures [31]. Thus, to explore the association of students’ growth mindset with their learning during the COVID-19 pandemic is of great significance for promoting their personal development and the efficiency of educational institutions.

2.2. Self-Regulated Learning

Self-regulated learning is described as “self-generated thoughts, feelings, and learning actions that are planned and cyclically adapted to the attainment of personal goals in learning” [32] (p. 14). It occurs under the mechanism of the individual’s self-control, in that self-disciplined students plan their learning process, schedule learning goals, and then apply personal learning strategies to achieve better learning outcomes. Thereafter, they control and monitor their learning process through self-evaluation and self-reflection, aiming at achieving academic goals through more efficient methods [32,33]. There are four shared assumptions that underpin the model of self-regulated learning: (1) learners can positively set their own learning goals and strategies; (2) learners can regulate learning-related factors including behaviors and environments, supervision, self-efficacy, self-judgment, recognitive motivation, and self-control; (3) learners can evaluate their learning behaviors by a few indexes such as goals, criteria, and pre-established standards; and (4) learning has the following determining factors: learners’ qualities or characteristics, their motivations, cognition, behaviors, and the context of learning [34].

Students’ characteristics attributed to self-regulated learning are in accordance with those attributed to students’ high performance and great academic success, and vice versa [33]. Self-regulated learning is often adopted by academically successful students, and, in return, it can enhance their time management ability, raise their awareness of metacognition, help regulate their efforts properly, improve their critical thinking strategies, and boost their self-efficacy [35,36]. Consequently, the learning efficiency and academic achievements of these learners can be improved through their monitoring, evaluation, and control

of the processes involved in learning. According to social cognitive theory, a bi-directional interaction among three vital factors can enhance a learner's self-regulation. One of these is self-observation in monitoring one's own actions, another is self-judgment in evaluating one's performance, and the last is self-reaction to one's performance outcomes [33]. Through the interaction of personal, behavioral, and environmental factors, an individual's self-regulated learning abilities tend to be developed over time, and poor-performing learners can develop their self-regulated learning strategies if provided with a suitable context [36]. As an emergency response to the pandemic, self-regulated learning has recently been proven to be effective [37–39], including a study on a total of 2536 students in China during the COVID-19 pandemic [40].

Since self-regulated learning plays a vital role in students' educational experiences, especially in such a challenging context as the COVID-19 pandemic, and students' growth mindset is known to be a strong predictor of their learning behaviors, it is worth investigating the pathways through which students' growth mindset may contribute to their intention toward self-regulated learning in the challenging setting of the COVID-19 pandemic.

2.3. Theory of Planned Behavior

Based on the Theory of Reasoned Action, the Theory of Planned Behavior was proposed by Ajzen [13]. It indicates that a person decides whether or not to proceed with a particular behavior based on their will or intention toward it, which means that an individual's behavioral intention predicts the performance of the behavior in question. In the Theory of Planned Behavior, three constructs were added based on the Theory of Reasoned Action: perceived behavioral control, behavioral attitude, and subjective norms [13]. According to this theory, an individual's behavioral intention can be increased by positive attitudes, supports or pressures from other people, and the perception of having the ability to control the situation.

Behavioral intention is described as the subjective probability of engaging in a particular behavior. However, there is a distinct difference between behavioral intention and attitude in the Theory of Planned Behavior. For example, when a person is going to perform a particular behavior, the intention consists of his or her powerful goal for performance, while behavioral attitude is the person's thinking preference, either positive or negative. Several studies have validated the relationship between behavioral attitude and intention, with intention viewed as the most proximal predictor of behavior [3,41–43]. Additionally, if an individual intends to perform a behavior and feels no barriers to performing it, then he or she presents a strong level of planned behavioral control, which is another construct in the model. Planned behavioral control can indicate whether or how much a person perceives difficulties while performing a particular behavior [13,44]. The last term in the Theory of Planned Behavior, subjective norms, is defined as the perceived social pressures that impact an individual's performance of a behavior, and it functions as an influential contextual factor [45].

The Theory of Planned Behavior model has been adopted in a range of research fields, such as studies of the utilization of virtual learning patterns, use of a particular information system, adoption of mobile devices for classroom learning, etc. [46,47] and its effectiveness has been validated as well [14–16]. Therefore, in order to fully explore the pathway from students' mindset to their intention toward self-regulated learning, the Theory of Planned Behavior is presented as an applicable theoretical model in this study.

2.4. Perceived Teacher Support

The role of teachers in student learning must not be ignored because their regular interactions with students build supporting contexts for them [48], assist their academic adjustment [49], and have an impact on their learning process [18]. Students' intention toward learning behaviors is enhanced under the environments developed by teachers, in which students can obtain the necessary support from their teachers, tutors, or advisors, and this is especially important in distance or online settings [3,19]. Usually, teacher sup-

port as perceived by students refers to the degree of students' trust in their teachers and the teachers' values they perceive during their interaction [50]. According to Wentzel [49], students can perceive their teachers' emotional support, instrumental support, appraisal support, and informational support. Among these, emotional support consists of the feelings of trust, care, and empathy that students perceive as coming from their teachers; instrumental support comprises teachers' abundant and timely assistance; appraisal support consists of the evaluation feedback given by teachers; and informational support refers to teacher's guidance, suggestions, and information to help students solve problems. Studies indicate that support from teachers for students is positively correlated with their learning engagement and academic achievement [51,52].

To elaborate more specifically, perceived teacher support is how much students view their teachers as an available resource when they need support [53]. Metheny, McWhirter and O'Neil [53] analyzed it in terms of four sub-variables, which are adopted in our study: (1) "invested" means students' perception of teachers' behaviors that are oriented toward students' future achievements and outcomes; (2) "positive regard" refers to students' belief that they are cared about emotionally by their teachers and that such caring is helpful to them; (3) "expectation" refers to teachers' active expectations that they express for students' academic engagement; and (4) "accessible" means students' perception that the teachers are always there ready to help whenever students are in need.

When teacher support is perceived by students, it builds a safe environment and is a strong predictor of students' learning behavior, including academic motivation, learning engagement, and academic achievements [51,52,54]. Moreover, according to the study by Sisk, Burgoyne, Sun, Butler and Macnamara [17], support or positive influences perceived by students function as a contextual factor for developing students' intelligence or ability, altering their level of growth mindset. Meanwhile there has been scarce research on the effect of a growth mindset on the relationship between perceived teacher support and students' intention toward learning, especially self-regulated learning behavior in the challenging context of the current COVID-19 pandemic. Thus, we take this question into consideration in this study.

2.5. Development of Research Hypotheses and Conceptual Framework

Studies on the growth mindset have shown that it functions as a predictor of several adaptive learning processes and positive learning behaviors. For example, it is correlated with learning positively and constructively [55], feeling less anxious in learning [56], and persisting in learning when encountering difficulties or failures [57]. Moreover, a growth mindset is connected with some motivational factors in learning, including setting task-oriented goals, performing self-regulated learning behaviors, holding beliefs of self-efficacy in learning [58], and aiming at greater academic outcomes [23]. Most importantly, learners who embrace a growth mindset tend to prioritize their learning goals and view effort as a productive process [23], have higher engagement in learning [27], display greater motivation when learning [28], and actively take on more difficult academic tasks [29]. Therefore, during self-regulated learning against the backdrop of the COVID-19 pandemic, students holding a growth mindset plan their learning procedure, schedule their learning goals, and develop strategies so as to achieve their learning outcomes. Hence, the following hypothesis was proposed:

Hypothesis 1 (H1). *Growth mindset is positively related to the intention toward self-regulated learning.*

In the Theory of Planned Behavior, the behavioral intention of an individual is viewed as the most predictive and proximal determinant of the given behavior, and behavior attitude, subjective norms, and perceived behavioral control are the main predictors of behavioral intention [44]. In the context of the COVID-19 pandemic, when routine instructional activities have been suspended without a visible end time, if students are aware

of the support and pressures of self-regulated learning from the people around them or expect little hindrance to performing with a self-regulated learning method, or have a favorable evaluation or appraisal of it, they are likely to develop their intention soon and engage in actively performing that learning. As either a psychological characteristic or an intra-individual characteristic, a growth mindset has been confirmed to play a major role in students' learning process [23]. For example, students with a growth mindset tend to have positive behavioral attitudes in learning, prioritize their learning goals, and have higher levels of learning engagement [9,11]. At the same time, students who endorse a growth mindset will treat challenges and difficulties as a part of learning, hold the belief that they have control over the learning process or ability, and can manage difficult tasks actively [23,29]. Thus, growth mindset is not only related to individuals' learning but also associated with the other three constructs in the Theory of Planned Behavior as it relates to learning: learning attitude and perceived behavioral control. The mediating effects of the constructs in the Theory of Planned Behavior have already been validated in some studies on human behaviors in learning contexts [3,6]. Thus, based on the above review and discussion, this research proposed the following hypotheses:

Hypothesis 2 (H2). *Growth mindset is positively related to the intention toward self-regulated learning through the mediating role of perceived behavioral control.*

Hypothesis 3 (H3). *Growth mindset is positively related to the intention toward self-regulated learning through the mediating role of learning attitude.*

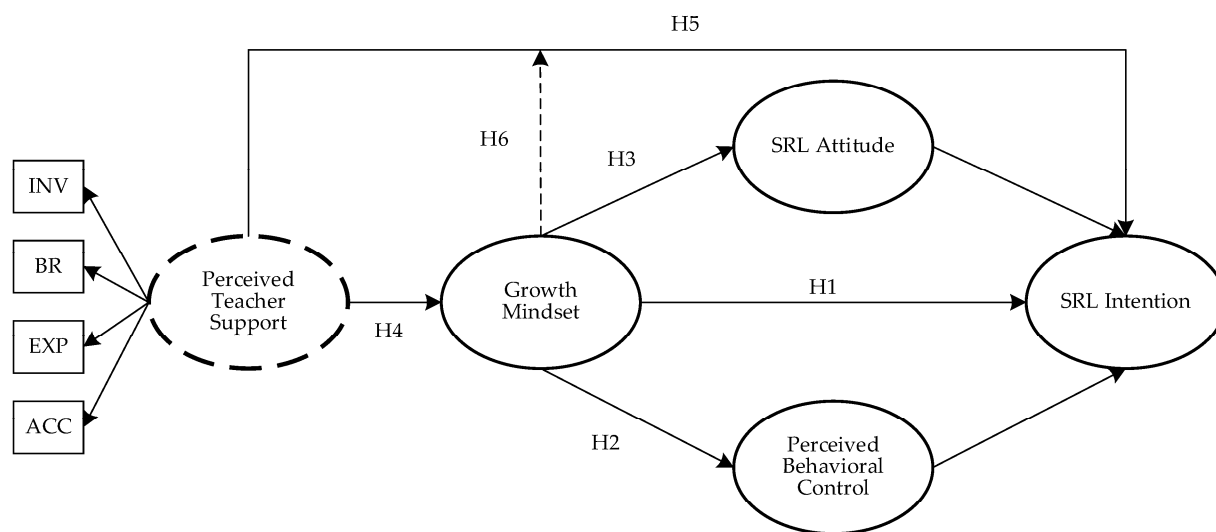
Skinner and Belmont [22] argued that support from teachers is significantly linked to students' learning. Teachers support students through building safe learning environments to convey information and messages, inspiring their learning intention [19,20]. Moreover, as a contextual factor for developing students' intelligence and abilities, teacher support is also a predictor of students' growth mindset [17]. Students with a high level of growth mindset are likely to perceive more satisfying social relationships, such as support or concern from teachers or advisors. Thus, students' growth mindset is not only a predictor of their learning intention, it is also associated with the support they perceive from their teachers. Consequently, when students embrace a higher level of growth mindset, the impact of the perceived teacher support on their learning intention will be greater. In light of all the findings described above, we formulated the following hypotheses:

Hypothesis 4 (H4). *Perceived teacher support is positively related to students' intention toward self-regulated learning.*

Hypothesis 5 (H5). *Growth mindset mediates the relationship between perceived teacher support and intention toward self-regulated learning.*

Hypothesis 6 (H6). *Growth mindset moderates the relationship between perceived teacher support and intention toward self-regulated learning.*

Figure 1 shows the conceptual framework for this research. Based on an extended theoretical model from the Theory of Planned Behavior, this study focused on exploring the effects of a growth mindset on student's intention toward self-regulated learning against the backdrop of the COVID-19 pandemic through its direct, indirect, mediating, and moderating roles.



○ Second-order reflective construct; ----> Moderation effect; SRL, self-regulated learning; INV, invested; BR, best regard; EXP, expectation; ACC, accessible.

Figure 1. Conceptual framework.

3. Methodology

3.1. Participants and Procedure

We collected data through an online questionnaire survey, not only because of the lockdowns and physical distancing policies of the COVID-19 pandemic era in China, but also because of the advantages of that method over others. It is possible to collect an abundance of data through an online survey, which can better help to complete data entry and processing. Online data collection can also ensure data integrity throughout the investigation process [59,60]. The target respondents in this study were college students enrolled in universities in China, whose student sizes range from about 10,000 to 30,000. The universities we surveyed were significantly influenced by the ongoing COVID-19 pandemic, and their educational activities on campus were interrupted because of the shutdown policies of the local governments. Therefore, some alternative learning strategies such as self-regulated learning outside the classroom or online have become regular methods for those students to continue learning.

A survey link describing the research purpose was sent out to the concerned students mainly through social networking groups, such as WeChat and QQ groups. Students voluntarily participated in the survey from 15 September 2022 to 7 October 2022, after experiencing some classroom suspension because of COVID-19 and having been pushed to experience some self-regulated learning to keep up with the educational pace of their universities. Altogether, 486 valid questionnaires were collected after some nonqualifying ones were deleted in SPSS. In accordance with the standards of sample size, the samples gathered in this study were sufficient for our purposes [61]. It is imperative to state that the interpretation of the main construct in the questionnaire, that is, self-regulated learning, was presented to students before they filled out the questionnaire in order to ensure that they understood the relevant terms.

The questionnaire was composed of two sections. Section 1 contained questions about the participants' demographic information and Section 2 comprised detailed questions measuring the variables in the proposed model. We adopted a Likert scale with seven points to measure the constructs, scored from 1 = *Strongly disagree* to 7 = *Strongly agree*. As the respondents were students from universities in China, the questionnaires were written in Chinese, and sufficient time was allotted for completion.

3.2. Measures and Data Analysis

As seen in the above literature review, all the constructs' operational definitions in this study have been confirmed and the measuring items were all adapted by the authors from those used in previous studies. Meanwhile it is imperative to state that the scales of the four sub-constructs of perceived teacher support: invested, best regard, expectation, and accessible [53], were adapted by the authors before investigation for the context of this research. To ensure the validity of the items in the survey, the questionnaire was sent to six relevant experts in this research area before the survey was conducted to evaluate its appropriateness and obtain advice for improvement. The items of the questionnaire were revised again by the authors following pretests and after expert consultation. The measurement items in this study are suitable for the current investigation context of the COVID-19 pandemic and are presented in Table 1.

Table 1. Questionnaire items and references.

Dimensions	Questions	References
Growth Mindset	GM1: My intelligence is something that I can't change very much. GM2: There are some things that I am not capable of learning. GM3: Challenging myself will not make me any smarter. GM4: If I am not naturally smart in a subject, I will never do well in it.	[62]
Invested	INV1: My teachers expect me to work hard at school. INV2: My teachers try to answer my questions in my study time. INV3: My teachers are interested in my growth. INV4: My teachers take the time to help me get better grades. INV5: My teachers think I am a hard-working student. INV6: My teachers are helpful when I have questions about my studies. INV7: My teachers are helpful when I have questions about school issues. INV8: My teachers would praise me before others when I perform well at school.	
Positive Regard	PR1: My teachers push me to gain good academic achievement. PR2: My teachers challenge me to think about my goals for my studies. PR3: My teachers believe I am smart so that I can study well by myself. PR4: My teachers help me understand my strengths in my studies. PR5: My teachers want me to do well in school.	[53]
Expectation	EXP1: My teachers enjoy having me as their student. EXP2: My teachers care about what happens to me at school. EXP3: My teachers encourage me to learn. EXP4: My teachers think I should study continuously. EXP5: My teachers support my goals for my studies.	
Accessible	ACC1: My teachers will listen if I want to talk about a problem in my studies. ACC2: My teachers are easy to talk to about my school things. ACC3: My teachers are easy to talk to about things beside school.	
Attention	ATTEN1: I intend to do self-regulated learning to improve my academic achievements. ATTEN2: I intend to continue doing my self-regulated learning frequently. ATTEN3: I will strongly recommend my peers to do self-regulated learning. ATTEN4: I will always try to do self-regulated learning on a daily basis. ATTEN5: Overall, I intend to continue self-regulated learning in future learning.	
Perceived Behavioral Control	PBC1: It is always possible for me to do my self-regulated learning. PBC2: If I want, I can always do self-regulated learning. PBC3: It is mostly up to me whether or not to do self-regulated learning. PBC4: I have control over how to do self-regulated learning. PBC5: I have the necessary knowledge to do self-regulated learning.	[44,63]
Attitude	ATTI1: I Look forward to those aspects of self-regulated learning. ATTI2: I like self-regulated learning. ATTI3: Self-regulated learning is a good idea. ATTI4: I have a generally favorable attitude toward self-regulated learning. ATTI5: Overall, self-regulated learning is beneficial.	[11]

In this research, partial least squares structural equation modeling (PLS-SEM) was utilized to analyze the proposed theoretical model using Smart PLS V.3.3.9 software [64]. PLS-SEM is a method focusing on the explained variance of the criterion variable and thus is the least restrictive method used in quantitative empirical research [65,66]. Therefore, PLS-SEM is an appropriate tool for studying the impact of students' growth mindset on their behavioral intention toward self-regulated learning in this study.

4. Results

4.1. Descriptive Analysis

Questionnaires were distributed to students at several universities in China that have been significantly influenced by the ongoing COVID-19 pandemic, during which these students have experienced self-regulated learning because of lockdowns or physical distancing policies. A total of 532 questionnaires were collected. After invalid questionnaires were discarded, this survey retained 486 valid responses (91.3%). Among them, 254 (52.3%) were females and 232 (47.7%) were males, aged 17–23 years old ($M = 20.68$, $SD = 1.34$). All respondents were undergraduates from grade 1 (Freshman) to grade 4 (Senior) studying for their bachelor's degrees.

4.2. Measurement Model Assessment

The outer model in this research was assessed by the following measures: the internal consistency and the reliability of each item, the convergent validity and discriminant validity of each construct, and severity of common method variance (CMV).

Table 2 gives the values of Cronbach's alpha, composite reliability, and average variance extracted (AVE). Hair, et al. [67] suggested that the reliability of the constructs be assessed by examining Cronbach's alpha and composite reliability. The convergent validity of the construct refers to the extent to which the measurements of two theoretically connected constructs' measurements are related [68]. As can be seen in Table 2, the Cronbach's alpha values fall between 0.911 and 0.978, exceeding the suggested threshold value of 0.7. Moreover, the composite reliability values are between 0.934 and 0.98, exceeding the threshold value of 0.7, and the values of AVE fall between 0.696 and 0.882, above the standard value of 0.5. The values of factor loadings for all constructs are above 0.7, indicating that they are acceptable. The results described above confirm the reliability and convergent validity of the model based on the established criteria [66,69].

Table 2. Reliability and validity results.

Constructs	Items	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE
ATT	ATT1	0.930	0.964	0.972	0.874
	ATT2	0.930			
	ATT3	0.954			
	ATT4	0.958			
	ATT5	0.903			
ACC	ACC1	0.900	0.933	0.957	0.882
	ACC2	0.958			
	ACC3	0.959			
GM	GM1	0.873	0.911	0.934	0.738
	GM2	0.872			
	GM3	0.770			
	GM4	0.909			
	GM5	0.866			
BR	BR1	0.919	0.942	0.956	0.812
	BR2	0.916			
	BR3	0.931			
	BR4	0.887			
	BR5	0.848			

Table 2. Cont.

Constructs	Items	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE
EXP	EXP1	0.850	0.916	0.937	0.749
	EXP2	0.909			
	EXP3	0.887			
	EXP4	0.799			
	EXP5	0.879			
INT	INT1	0.884	0.950	0.961	0.832
	INT2	0.933			
	INT3	0.902			
	INT4	0.918			
	INT5	0.924			
INV	INV1	0.824	0.943	0.953	0.717
	INV2	0.852			
	INV3	0.872			
	INV4	0.863			
	INV5	0.760			
	INV6	0.871			
	INV7	0.87			
	INV8	0.858			
PBC	PBC1	0.878	0.942	0.956	0.812
	PBC2	0.906			
	PBC3	0.879			
	PBC4	0.934			
	PBC5	0.910			

ACC, accessible; GM, growth mindset; BR, best regard; EXP, expectation; INT, intention; INV, invested; PBC, perceived behavioral control; ATT, attitude; AVE, average variance extracted. PTS is a second-order reflective construct so no estimation here.

The discriminant validity measures the degree to which one item in the set can be distinguished from another. To measure the discriminant validity of the constructs, we mainly adopted the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio (HTMT). Based on the standard of the Fornell–Larcker criterion, discriminant validity is achieved on either of two conditions: one is that the AVE square root of the construct shows more significance than its bi-variate association with other variables, and the other is that the factor loading of the construct is higher than the others [70]. Hair, Hollingsworth, Randolph and Chong [66] have emphasized that the values on the diagonal line are directly proportional to the validity of the discriminant. As can be seen from the bold numbers in Table 3, the AVE square root of each construct shows more significance than its bi-variate association with other constructs, so discriminant validity can be obtained. Furthermore, the discriminant validity will be confirmed when HTMT values do not exceed the suggested standard of 0.90 [71]. The discriminant validity in this study is acceptable because the HTMT values between the constructs from the research results are all below the 0.9 threshold (see Table 4). As a result, the internal consistency, the reliability of each item, the convergent validity, and the discriminant validity are all confirmed in this study. There is a possibility that common method variance (CMV) could have arisen from the cognitive information of student respondents collected through self-reported scales. Therefore, to reduce the influence of CMV, we took preventive measures in our research. In addition to the use of an anonymous survey, the purposes of the questions for the different constructs were deliberately hidden. Moreover, the variable results confirm the construct validity, which also shows that the results are not greatly impacted by CMV (see Tables 3 and 4). Additionally, the severity of CMV in this study was tested by adopting Harman's One-Factor Test [72]. Exploratory factor analysis for the 45 questions in the survey indicates that the explanatory variance for the first factor is 38.91%, which is below the standard of 50%, and, moreover, it is a non-integrated factor, suggesting that there is no serious problem of CMV in this study.

Table 3. Fornell–Larcker criterion.

	ACC	ATT	BR	EXP	INT	INV	GM	PBC
ACC	0.939							
ATT	0.494	0.935						
BR	0.839	0.515	0.901					
EXP	0.862	0.518	0.808	0.865				
INT	0.570	0.832	0.585	0.603	0.912			
INV	0.817	0.503	0.888	0.868	0.581	0.847		
GM	0.538	0.396	0.600	0.574	0.448	0.597	0.859	
PBC	0.611	0.616	0.669	0.684	0.720	0.669	0.479	0.901

Diagonal elements in bold are the square root of the AVE. ACC, accessible; BR, best regard; EXP, expectation; INT, intention; INV, invested; PBC, perceived behavioral control; SN, subjective norms; ATT, attitude. PTS is a second-order reflective construct so no estimation here.

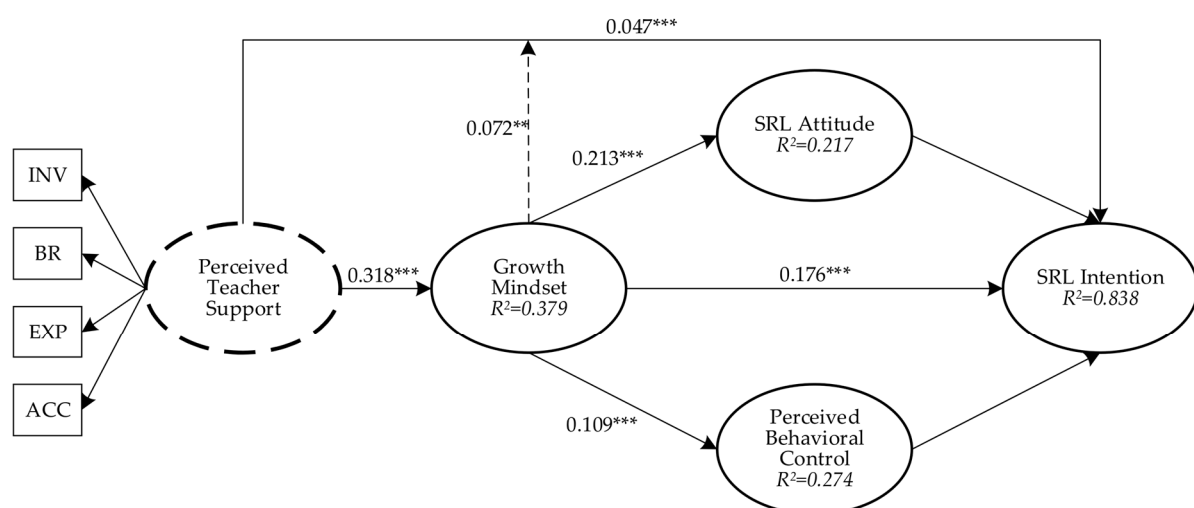
Table 4. Heterotrait–Monotrait ratio (HTMT).

	ACC	ATT	BR	EXP	INT	INV	GM
ACC							
ATT	0.522						
BR	0.895	0.541					
EXP	0.832	0.552	0.876				
INT	0.606	0.869	0.619	0.648			
INV	0.871	0.528	0.842	0.833	0.615		
GM	0.576	0.419	0.640	0.622	0.476	0.638	
PBC	0.651	0.646	0.709	0.734	0.761	0.708	0.511

ACC, accessible; GM, growth mindset; BR, best regard; EXP, expectation; INT, intention; INV, invested; PBC, perceived behavioral control; ATT, attitude. PTS is a second-order reflective construct so no estimation here.

4.3. Structural Model Assessment

The inner model was assessed through the bootstrapping procedure of 5000 re-samples and a blindfolding procedure using Smart-PLS software. We obtained the standard beta (β), t-value, p value, coefficient of determination (R^2), and Q-square (Q^2) values [66]. The hypothesis testing results are shown in Table 5 and Figure 2, indicating that all the hypotheses are supported.



○ Second-order reflective construct; ---→ Moderation effect; SRL, self-regulated learning; INV, invested; BR, best regard; EXP, expectation; ACC, accessible. *** $p < 0.001$; ** $p < 0.05$.

Figure 2. Significance of inner model and results of path coefficient.

Table 5. Path coefficients.

Hypothesis	Relationship	Original Sample	Standard Deviation	T Statistics	Decision
H1	GM → INT	0.176 ***	0.047	3.742	Supported
H2	GM → PBC → INT	0.109 ***	0.020	5.514	Supported
H3	GM → ATT → INT	0.213 ***	0.026	8.142	Supported
H4	PTS → INT	0.596 ***	0.047	12.619	Supported
H5	PTS → GM → INT	0.318 ***	0.033	9.758	Supported
H6	Moderation Effect of GM (PTS → INT)	0.072 **	0.036	2.015	Supported

GM, growth mindset; INT, intention; PBC, perceived behavioral control; ATT, attitude; PTS, perceived teacher support. *** $p < 0.001$; ** $p < 0.05$.

The results show that growth mindset ($\beta = 0.047$, $t = 3.742$, $p < 0.001$) was positively associated with self-regulated learning intention, supporting the first hypothesis of the study (H1). Consistent with H2, and H3, growth mindset was positively related to self-regulated learning intention through the mediators perceived behavioral control ($\beta = 0.02$, $t = 5.514$, $p < 0.001$), and learning attitude ($\beta = 0.026$, $t = 8.142$, $p < 0.001$). Hence, H2 and H3 are confirmed (see Table 5). In line with H4, the results showed that students' perceived teacher support is positively related to intention toward self-regulated learning ($\beta = 0.047$, $t = 12.619$, $p < 0.001$). Hence, H4 can be supported. In agreement with H5 and H6, we found that growth mindset has a positive mediating effect on the relationship between perceived teacher support and students' self-regulated learning intention ($\beta = 0.033$, $t = 9.758$, $p < 0.001$), and growth mindset also plays a positive moderating role in the association between these two constructs ($\beta = 0.036$, $t = 2.015$, $p = 0.044$). The results indicate that the effect of perceived teacher support on students' learning intention is positive when the level of growth mindset is high and becomes less positive if the level of growth mindset is low, but the moderation effect is not strong enough to reach the level of significance. Thus, growth mindset, as an intra-individual characteristic, significantly mediated the relationship between students' perceived teacher support and their self-regulated learning intention, and mildly moderated the association of these two variables. These results support H5 and H6 (see Table 5).

As we can see from the (R^2) results, perceived teacher support explains 37.9% of the variance in self-regulated learning attitude (see Figure 2). Furthermore, growth mindset, perceived teacher support, perceived behavioral control, and learning attitude together explain 83.8% of the variance in students' intention toward self-regulated learning. According to the values of (R^2) suggested by Chin [73], the (R^2) values obtained in this study are acceptable.

The values of Q^2 are all greater than the standard of zero, including accessible ($Q^2 = 0.723$), best regard ($Q^2 = 0.746$), expectation ($Q^2 = 0.681$), growth mindset ($Q^2 = 0.230$), intention ($Q^2 = 0.664$), and invested ($Q^2 = 0.657$), which establishes that the proposed model has sufficient predictive power [70]. To evaluate the quality of the proposed model, the Goodness of Fit (GoF) was also computed [74]. The GoF is calculated as:

$$\text{GoF} = \sqrt{\text{AVE} \times R^2} = \sqrt{0.825 \times 0.618} = 0.714$$

The result shows that the GoF of the model is 0.714, above the threshold criterion of 0.36 for a large effect size [75]. This indicates that the Goodness of Fit is acceptable.

5. Discussion

5.1. Discussion of Findings

The present study aimed to explore the association between growth mindset and students' intention toward self-regulated learning against the background of the COVID-19 pandemic based on an extended model of the Theory of Planned Behavior, as well as investigating the mediating and moderating effects of growth mindset on the relationship between perceived teacher support and intention toward self-regulated learning. Through PLS-SEM research and analyses, the positive effects of growth mindset on students' inten-

tion toward self-regulated learning were confirmed, including its direct, indirect, mediating, and moderating roles as presented in the proposed model.

As for the influence of growth mindset on students' intention toward self-regulated learning in the setting of the COVID-19 pandemic, the findings validate the proposed hypotheses (H1, H2, H3). Students' growth mindset has a greatly positive direct effect on their intention toward self-regulated learning, and also has significantly positive impacts on it through the mediating effects of perceived behavioral control and students' attitude toward self-regulated learning. These findings agree with prior studies on the relationships between these variables concerning individuals' learning processes. First, as an intra-individual characteristic, growth mindset is known to help establish learning motivation [29,31], enhancing learners' motivation to prioritize learning goals and their intention to view learning efforts as productive and rewarding [23]. It can also make learners actively involved in their learning [27]. Consequently, individuals embracing a greater growth mindset have a higher level of intention for self-regulated learning under the challenging setting of the COVID-19 pandemic. Thus, they can make much progress and gain achievements through the learning process by mentoring, reinforcing, evaluating, correcting, and instructing by themselves under such challenging conditions [32] (H1). Moreover, according to the Theory of Planned Behavior, when learners hold a more positive attitude toward the learning behavior and have a greater belief in their capability to manage the learning, the person's learning intention may increase [13,44]. As one of a psychological characteristics, growth mindset can increase learners' persistence [24] and push them to actively take on more difficult learning tasks [29]. Thus, students with a positive growth mindset are likely to have a stronger belief that they have the ability to control the situation of self-regulated learning [23], even in the setting of the COVID-19 pandemic. This way of thinking is described as their planned behavior control in the Theory of Planned Behavior [44]. Thus, growth mindset plays an essential role in the process of self-regulated learning during the COVID-19 pandemic, as it is positively related to students' self-regulated learning intention through the mediation of their perceived behavior control and learning attitude (H2, H3).

The results also validated the effect of perceived teacher support and students' intention toward self-regulated learning (H4). Teachers' regular interactions with students build safe and supportive learning environments for them in challenging settings, inspiring their learning intention [19,20], especially in the setting of COVID-19 when students have to engage in self-regulated learning. When facing self-regulated learning in the setting of COVID-19, if students can perceive the feeling of trust, care, and empathy (emotional support) from teachers, obtain abundant and timely assistance (instrumental support), evaluation feedback (appraisal support), and the guidance and suggestions for self-regulated learning (informational support) from teachers, students' intention toward self-regulated learning engagement will be greatly enhanced [48,49,52] (H4). Besides, the effects of a growth mindset on the relationship between perceived teacher support and intention toward self-regulated learning are consistent with the results of prior studies [17,22]. Learners' growth mindset has a mediating effect and a moderating role in the relationship between perceived teacher support and students' intention toward self-regulated learning during the COVID-19 pandemic (H5, H6). The degree of students' trust in their teachers or the values of the teachers they perceive during their interaction is related to their learning process [50], such as their learning intention and academic outcomes [22]. When students feel teachers' care and assistance, or obtain positive evaluation feedback and timely guidance, these factors build a necessary context for students' learning [19]. Sisk, Burgoyne, Sun, Butler and Macnamara [17] have indicated that teacher support can act as a predicator of students' growth mindset, and it is a contextual factor for improving students' intelligence or ability and developing their level of growth mindset. Consequently, when facing the situation of self-regulated learning during the COVID-19 pandemic, the more support students perceive from their teachers, the more they believe in their ability to perform the learning behavior, which indicates a higher level of growth mindset. Thus, their intention

toward the performance of learning is also enhanced [44]. Besides, the results of the study show that growth mindset mildly moderates the association of perceived teacher support with students' intention toward self-regulated learning. This may be explained by the fact that students with a high level of growth mindset perceive more support from their teachers [17], and thus their intention toward self-regulated learning is increased [19]. That is to say, growth mindset is a moderator in the relationship between perceived teacher support and intention toward self-regulated learning, although this effect is moderate or not very significant, partially because undesirable factors may interfere with the process of perceiving teacher support in these challenging contexts [76,77], such as the COVID-19 pandemic. Consequently, students perceive less support than what teachers actually provide them with, or their learning process is affected to some degree by the lack of required equipment and skills, resulting in a relatively weaker moderation effect even if learners have a high level of growth mindset. Thus, for students engaged in self-regulated learning under the current situation of the COVID-19 pandemic, their growth mindset can function as a mediator as well as a moderator in the association between perceived teacher support and their intention toward self-regulated learning (H5, H6).

In summary, the results of our study indicate that students' growth mindset is positively related, both directly and indirectly, to their intention toward self-regulated learning under the challenging situation of the COVID-19 pandemic. No matter what support students perceive (e.g., emotional, instrumental, appraisal, and informational), learners with a growth mindset have a great belief that they have the ability to manage their self-regulated learning and believe it to be beneficial and necessary for their academic development [29]. Consequently, they are willing to plan their learning process, schedule learning goals, and then apply personal learning strategies so as to achieve better learning outcomes. Thereafter, they control and monitor their learning process through self-evaluation and self-reflection, aiming at achieving academic goals by more efficient methods [32,33].

5.2. Limitations and Implications

5.2.1. Limitations

This study has several limitations which should be discussed. First is the use of self-reported questionnaires in this study because surveys of this type can be affected by factors such as social desirability. Second, this research adopted a quantitative method (i.e., an online questionnaire survey), and thus qualitative research, such as interviews and observations, could be adopted in the future to make further progress in exploring this subject. Third, in addition to perceived teacher support and the constructs in the Theory of Planned Behavior, the effect of a growth mindset on learning intention could be explored through their association with other variables, such as self-efficacy, motivation, campus involvement, institutional integrity, etc. Lastly, the study focused only on students studying for bachelor's degrees in China and in universities influenced significantly by COVID-19. Future relevant studies could focus on student samples from different educational levels or systems, or even from different cultures and in other challenging educational contexts, allowing for wider inferences and broader investigation, thereby improving the generalizability of the research.

5.2.2. Implications

The findings of the research have some practical implications. The results emphasize that students' growth mindset is positively associated with their intention toward self-regulated learning directly, and indirectly through perceived behavioral control and behavioral attitude. Thus, under circumstances when self-regulated learning for university students becomes indispensable, such as the COVID-19 pandemic in China, it is essential for university administrators to focus more on students' mindsets and make timely interventions in developing their level of growth mindset [78]. Firstly, administrators can develop their understanding of how and why mindsets help students improve academic outcomes, especially self-regulated learning achievements in the setting of the COVID-19

pandemic. They can do so by examining existing programs (e.g., www.mindsetkit.org, accessed on 24 December 2022), or referring to researchers' findings on growth mindset interventions. Thereafter, the administrators of the universities should take fostering a growth mindset as an education priority and include it on their agenda. For those influenced by the COVID-19 pandemic, the administrators of the university can establish an online growth mindset intervention program which is student-directed, teacher-led, and then implement it university-wide [79]. Besides, they can encourage and sponsor relevant programs or conferences launched by their second-level colleges to develop and implement the growth mindset interventions. In addition, school administrators can attempt to create specific courses for students to teach growth mindset or provide students with relevant online learning materials, such as selecting textbooks and learning materials that effectively incorporate growth mindset education. Additionally, programs to train and coach teachers on how to effectively promote a growth mindset in their students can be developed. Meanwhile, the administrators need to assess the effectiveness of teachers' training in order to improve their expertise in the development of students' growth mindset.

Moreover, the findings show that students' growth mindset plays a mediating and moderating role in the relationship between perceived teacher support and students' intention toward self-regulated learning. Thus increased efficiency and frequency of student-teacher interactions can guarantee that necessary support is more readily perceived by students, offering another solution to building students' confidence in their own intelligence and learning ability [80]. Therefore, teachers' behaviors should be oriented toward students' future achievements and outcomes, such as expecting them to work hard at school, answering students' questions in study time, taking time to help them get better grades, and praising students before others when they perform well at school [81]. In addition, teachers should care about students emotionally which is helpful to them, such as pushing them to gain good academic achievement, challenging them to think about their study goals, helping understand their study strengths, and wanting them to do well in school. Besides, teachers can express active expectations for students' academic engagement, such as caring about what happens to them at school, encouraging them to learn, and supporting their study goals. At the same time, it is better for teachers to be always there ready to help whenever students are in need, such as listening to them if students want to talk about a problem in their study time and being easy to talk to about school things with students.

Apart from the above practical implications, the findings of the study contribute to the literature on the growth mindset and extend the adoption of the Planned Behavior Theory. So, this study provides new perspectives on the relevant research for scholars. Future research on the growth mindset can be conducted based on the results of this study, exploring them more extensively.

6. Conclusions

This research was conducted based on an extended model of the Planned Behavior Theory [13] by adopting a PLS-SEM approach. The findings validated the direct, indirect, mediating, and moderating roles of students' growth mindset on their intention toward self-regulated learning against the backdrop of the COVID-19 pandemic. In the context of the ongoing pandemic, students' growth mindset was found to play a significantly positive role in this learning process, whether through the mediating paths of planned behavioral control and students' learning attitude, or through the direct path to students' intention toward self-regulated learning. Moreover, students' level of growth mindset was found to positively mediate and moderate the relationship between perceived teacher support and their intention toward self-regulated learning. This study contributes to the research on the growth mindset in self-regulated learning, along with that of teacher support in students' learning and the adoption of the Planned Behavior Theory. The results should prompt educators, policymakers, and even researchers to put more emphasis on the role of students' growth mindset in their learning process, especially in terms of self-regulated

learning amid challenging situations like the ongoing COVID-19 pandemic, to enhance their learning intention and improve the overall levels of academic achievement.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data are currently not publicly available due to participants' privacy, but they are available from the first author upon reasonable request.

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