The chain mediating role of intrinsic motivation and academic engagement between teacher support and academic achievement among college students

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Abstract

Numerous studies have examined the direct and indirect relationships between teacher support and academic achievement in learners, primarily adolescents in the US, China, and other countries, but Vietnam has been excluded. This study aimed to investigate the mediating role of intrinsic motivation and engagement between teacher support and academic achievement among college students in Vietnam. Six hundred forty-two Vietnamese college students (78.3% female) completed measures of perceived teacher support, intrinsic motivation, academic engagement, and academic achievement. SPSS 20 and SMART PLS 3.9 software were used for data analysis. The results of the study showed that teacher support is not directly related to

academic achievement (B = 0.039, p > 0.05); academic engagement is fully mediated between teacher support and academic achievement (B = 0.076, 95% CI = [0.039; 0.114]); intrinsic motivation and academic engagement are fully chain mediated between teacher support and academic achievement (B = 0.021, 95% CI = [0.011; 0.033]). The results emphasize the role of intrinsic motivation and academic engagement between teacher support and academic achievement among college students. According to the findings of this study, to improve students' academic achievement, measures should be strengthened on teacher support, intrinsic motivation and academic engagement.

***Keywords*:** Academic engagement; academic achievement, college students; intrinsic motivation; teacher support

1. Introduction

Academic achievement (GPA) has always been a concern and challenge for researchers and educators (Tannoubi et al., 2023). GPA, traditionally conceptualized as grade point average, is a common indicator of student academic success (de la Fuente et al., 2020; Tannoubi et al., 2023). Grade point average can indicate completion of educational goals, and GPA at the university level (Alhadabi & Karpinski, 2020; Tannoubi et al., 2023). GPA is a multifaceted, complex phenomenon that is influenced by many factors, such as situational, institutional, and individual factors (Agarkar & Brock, 2017; Tannoubi et al., 2023). Furthermore,

GPA is also an important indicator of student success (Beard & Thomson, 2021). According to previous studies, students' GPA is related to many factors, such as teacher support (TS) (Ansong et al., 2024; Peng et al., 2022; Tao et al., 2022), intrinsic motivation (IM) (Bin Abdulrahman et al., 2023; Hayat et al., 2018; Kaufman et al., 2008; Khalid & Abdul Rahman, 2023; Trevino & DeFreitas, 2014), and academic engagement (AEG) (Casuso-Holgado et al., 2013; Estévez et al., 2021; Froiland & Worrell, 2016; Tannoubi et al., 2023).

1.1. TS and GPA

According to the authors, TS is the availability of social resources in the teacher-student relationship that helps students cope with difficult school-related tasks or overcome negative situations (Ulmanen et al., 2023; Wentzel et al., 2016). Teachers' support for students can be through encouragement, providing students with development opportunities, and fair treatment (Peng et al., 2022). There is a lot of evidence in the literature that teachers' support has a direct and indirect relationship with students' GPA. On the one hand, it was found that there is a strong and positive relationship between TS and GPA (Ansong et al., 2024; Peng et al., 2022; Tao et al., 2022). These findings were found in adolescent samples in the United States (Ansong et al., 2024), China (Peng et al., 2022), and many other countries (Tao et al., 2022). On the other hand, the relationship between TS and learners' GPA was mediated by AEG (L. Huang & Wang, 2023; Peng et al., 2022; Tao et al., 2022), homework behavior (Ansong et al., 2024), academic motivation

(An et al., 2022), academic self-efficacy (L. Huang & Wang, 2023). This association may be moderated by gender (Ansong et al., 2024). According to previous studies, TS can create a positive psychological atmosphere in the classroom (Ryan & Deci, 2000), which stimulates and promotes academic motivation (especially IM) (Karimi & Fallah, 2021) and induces positive learning behaviors (such as persevering through challenges and pursuing learning goals) (Karimi & Fallah, 2021; Ryan & Deci, 2000), thereby improving GPA (Peng et al., 2022). Furthermore, TS tends to increase homework behavior, AEG and confidence in their ability to perform academic tasks (high academic self-efficacy), thereby improving learners' academic performance (Ansong et al., 2024; L. Huang & Wang, 2023; Peng et al., 2022; Tao et al., 2022). Based on previous studies, this study proposes the following hypothesis: TS is positively related to students' GPA (H1).

1.3. The potential mediating effect of IM

TS is an important factor that influences students' academic motivation (Karimi & Fallah, 2021). There are two main types of motivation: extrinsic motivation and IM (Deci et al., 1991; Vallerand et al., 1992). IM is a concept that refers to an individual's internal desire to perform an action or pursue a goal because it is inherently satisfying and enjoyable, as opposed to extrinsic motivation that originates from outside the individual (Deci & Ryan, 1985; Karimi & Fallah, 2021). In other words, IM represents performing an activity for enjoyment or interest (Kanellopoulou & Giannakoulopoulos, 2020) without expecting external rewards

(Mercader-Rubio et al., 2023). According to Karimi and Fallah (2021), professors can play an important role in helping students increase their IM. Indeed, many previous studies have found a positive relationship between TS and learners' intrinsic academic motivation (Chiu et al., 2023; Dietrich et al., 2015; Hung, 2020; Karimi & Fallah, 2021; Pap et al., 2021). For example, TS was associated with increased IM to learn a foreign language among learners in China (Hung, 2020) and Iran (Karimi & Fallah, 2021), and this relationship was explained by the level of language learning enjoyment and anxiety (Hung, 2020). A study of adolescents in grades 5 and 6 in Germany found that TS in one subject tended to increase students' IM and effort in another subject (Dietrich et al., 2015). Similar results were found in a longitudinal study of high school and university students in Romania (Pap et al., 2021) and 10th grade students in Hong Kong (Chiu et al., 2023). According to Self-determination Theory, TS as a social factor can satisfy students' needs for relatedness and competence, and the satisfaction of these needs promotes students' IM (Federici & Skaalvik, 2014; Karimi & Fallah, 2021; Pap et al., 2021). On the other hand, TS contributes to creating a positive relationship with students and creating a favorable learning environment, which in turn promotes an increase in students' IM, persistence in overcoming challenges, and pursuit of learning goals (Karimi & Fallah, 2021; Ryan & Deci, 2000). In addition, the positive relationship between TS and students' IM is explained through academic anxiety and enjoyment (Hung, 2020).

Academic motivation is an important factor in GPA. The higher the students' academic motivation, the higher their learning perseverance, learning quality, and GPA (Bin Abdulrahman et al., 2023; Pelaccia & Viau, 2017; Yousefy et al., 2012). In the literature, many studies have reported that high IM is associated with increased GPA (Bin Abdulrahman et al., 2023; Hayat et al., 2018; Kaufman et al., 2008; Khalid & Abdul Rahman, 2023; Trevino & DeFreitas, 2014). These findings were found in samples of medical students in Saudi Arabia (Bin Abdulrahman et al., 2023), Iran (Hayat et al., 2018), and university students in the United States (Kaufman et al., 2008; Trevino & DeFreitas, 2014), Malaysia (Khalid & Abdul Rahman, 2023), and Israel (Khalaila, 2015). A few studies have also found potential mediating mechanisms of the relationship between IM and GPA, such as academic integration (Clark et al., 2014) and AEG (Froiland & Worrell, 2016). In addition, the good qualities of learners formed by IM, including good study habits, adaptive cognitive strategies, and persistence in pursuing learning goals, can increase their GPA (Simons et al., 2004; Trevino & DeFreitas, 2014). Based on previous studies, this study proposes the following hypothesis: IM mediates the relationship between TS and GPA (H2).

1.4. The potential mediating effect of AEG

Student AEG is the foundation of educational achievement in higher education systems. According to engagement theory, cognitive, emotional, and behavioral engagement are identified as three important components (Çali et al.,

2024; Fredricks et al., 2004). In this study, we investigated students' behavioral engagement. Behavioral engagement refers to the efforts and time that learners spend on learning activities, reflecting whether learners accept teachers' learning requirements and school rules (Fredricks et al., 2004; T. D. Nguyen et al., 2018; Pan, 2023). Recent studies have reported a positive correlation between TS and learner engagement (Li, 2024; Shen et al., 2024; Xu et al., 2024; Yin & Luo, 2024). These studies were conducted on a sample of university students in China (Li, 2024; Shen et al., 2024; Xu et al., 2024; Yin & Luo, 2024). These findings in China support older research results found in samples of adolescents in Malaysia (Jelas et al., 2016) and university students in Iran (Sadoughi & Hejazi, 2021). According to previous studies, students with high levels of TS may have positive learning attitudes and resilience (Liu et al., 2023), higher academic self-efficacy (Alamri, 2022), and higher social interaction skills (J. Huang et al., 2022), thereby motivating students to spend more time and effort in learning (J. Huang et al., 2022; Liu et al., 2023). In addition, this relationship is explained through many mechanisms such as satisfaction of psychological needs and learning motivation (Xu et al., 2023, 2024), positive emotions (Ekatushabe et al., 2021; Sadoughi & Hejazi, 2021; Shen et al., 2024), and self-regulation (Yin & Luo, 2024).

Previous studies have reported that there is a positive relationship between AEG and learners' GPA (Casuso-Holgado et al., 2013; Estévez et al., 2021; Froiland & Worrell, 2016; García-Martínez et al., 2021; Lei et al., 2018; Tannoubi et al.,

2023). The findings were found in a sample of high school students in the United States (Froiland & Worrell, 2016), in a sample of elementary school students (Estévez et al., 2021) and college students in Spain (Casuso-Holgado et al., 2013; García-Martínez et al., 2021), and in a sample of college students in Germany (Tannoubi et al., 2023). Similar findings on this relationship were also found in a meta-analysis of 69 other studies with 196,473 participants (Lei et al., 2018). Lei et al. (2018) further revealed that the positive relationship between AEG and GPA was moderated by gender, cultural values, and method of reporting engagement. According to the participation-identification model of student engagement (Finn, 1989), when students are actively involved in learning activities, they can achieve better academic performance, and this makes them perceive the importance of learning more clearly. This awareness in turn motivates students to put in more effort in their studies and thus achieve higher GPAs (Lei et al., 2018). This process is a positive feedback loop (Lei et al., 2018). Furthermore, high levels of AEG make students show vigour, absorption, and dedication in solving learning tasks, thereby promoting increased GPA (García-Martínez et al., 2021). Based on the above evidence, we hypothesize that AEG mediates the relationship between TS and GPA (H3).

1.5. The potential chain mediating effect of IM and AEG

As presented in the above hypotheses, evidence of single paths that may serve as a basis for considering the serial mediating role of IM and AEG in the relationship

has been established. First, there exists a positive correlation between TS and IM (Chiu et al., 2023; Dietrich et al., 2015; Hung, 2020; Karimi & Fallah, 2021; Pap et al., 2021). Second, IM was found to be associated with increased AEG in a sample of secondary school students in Spain (Suárez et al., 2019), a sample of university students in China (Pan, 2023), Hong Kong (Siu et al., 2014) and Saudi Arabia (Mohamed Mohamed Bayoumy & Alsayed, 2021), and a sample of international students in China (Zang et al., 2022). This means that as the level of IM varies, the level of AEG of students will also vary. Students with a high IM to learn will put in more effort and invest more time in learning tasks (Pan, 2023; Suárez et al., 2019). According to Acosta-Gonzaga (2023), high IM stimulates students to increase their attention in class, increase their effort in learning, and be active in their own learning activities. Third, students with high levels of AEG tend to report higher GPAs (Casuso-Holgado et al., 2013; Estévez et al., 2021; Froiland & Worrell, 2016; García-Martínez et al., 2021; Lei et al., 2018; Tannoubi et al., 2023). Based on this evidence, we propose the hypothesis that IM and AEG chain mediate the relationship between TS and student GPA (H4).

1.6. The current study

The above analyses show that there are many studies that have demonstrated the link between TS and GPA (Ansong et al., 2024; Peng et al., 2022; Tao et al., 2022) as well as the potential indirect mechanisms underlying this relationship (Ansong et al., 2024; L. Huang & Wang, 2023; Peng et al., 2022; Tao et al., 2022).

These studies were mainly focused on the US (Ansong et al., 2024), China (L. Huang & Wang, 2023; Peng et al., 2022), and other countries (Tao et al., 2022), but not in Vietnam. The participants were mainly adolescents in high schools (Ansong et al., 2024; L. Huang & Wang, 2023; Peng et al., 2022; Tao et al., 2022). The mediators of this relationship have been reported to include AEG (L. Huang & Wang, 2023; Peng et al., 2022; Tao et al., 2022), homework behavior (Ansong et al., 2024), and academic self-efficacy. Thus, there is still a considerable gap in the research on the relationship between TS and GPA in a sample of university students in Vietnam. To date, no research has been found that simultaneously assesses the role of IM and AEG in the above relationship among learners.

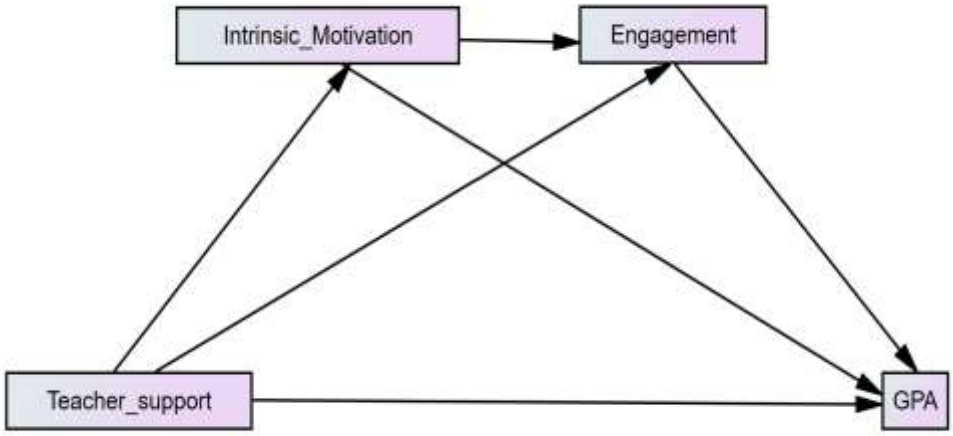

Fig.1. Hypothetical model

With the aim of adding new insights into the direct and indirect relationships between TS and learners' GPA, the current study investigates the mediating effects of

IM and AEG in the relationship between TS and GPA in a new context and with a new research subject: a sample of university students in Vietnam.

2. Methods

2.1. Sample (n = 642)

A total of 642 students at a university of education in the central region of Vietnam participated in the study. The sample was unbalanced in terms of gender and grade level, specifically: 78.3% female students and 21.7% male students; 35.2% first-year students, 56.1% second-year students, and 8.7% third-year students. The mean age of the participants was 18.79 (SD = 1.114). In terms of geographical location, 52.6% of the students came from rural areas and 47.4% of the students came from urban areas.

This study used a cross-sectional research design and convenience sampling method. Data collection was conducted from September to October 2023. Students were first invited to participate in the study through lecturers. Participants must be undergraduate students in the study area and be able to complete the online questionnaire. Students who agree to participate will be asked to sign a consent form. Students then completed an online survey questionnaire that included measures of TS, IM, AEG, and GPA. The survey took approximately 15–20 minutes for each student. Students were also informed that all information would be kept confidential and used for research purposes only.

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Table 1. Characteristics of the study sample

Variables	Classification	n	%
Gender	Males	139	21.7
	Females	503	78.3
Levels	First-year students	226	35.2
	Second-year students	360	56.1
	Third-year students	56	8.7
Geographical location	Rural areas	338	52.6
	Urban areas	304	47.4
Age (M ± SD): 18.79 ± 1.114			

2.2. Materials

This study used self-report scales to collect data on TS, IM, AEG, and GPA.

TS: To measure TS, two items of the Learning Support scale were used (Jelas et al., 2016). The Learning Support scale is a self-report scale consisting of 11 items corresponding to 3 subscales to measure learning support from parents (6 items), friends (3 items), and teachers (2 items). All items of this scale use a 5-point Likert scale, ranging from never (1 point) to very often (5 points). Two items measuring TS

include “At my school, there is a teacher who cares about me” and “At my school, there is a teacher who listens to me when I have something to say” (Jelas et al., 2016). Total scores on the TS subscale ranged from 2 to 10, with higher scores indicating higher levels of TS. Jelas et al. (2016) reported that the reliability of the TS subscale was 0.81. In this study, the scale had good reliability and validity (α = 0.854; CR = 0.932 and AVE = 0.872) (see Table 2).

IM: IM was assessed using the 12 items of the Academic Motivation Scale (Vallerand et al., 1992). The Academic Motivation Scale consists of 28 items corresponding to 7 subscales. Three subscales (12 items) to measure participants' IM include IM toward achievement and accomplishment; IM to know and learn; and IM to experience stimulation. All items of the scale use a 7-point Likert scale ranging from not true at all (1 point) to very true (7 points). Sample items include “Because my studies allow me to continue to learn about many things that interest me”, “For the pleasure I experience while surpassing myself in my studies”, and “For the pleasure that I experience when I read interesting authors”. Total scores on the IM scale ranged from 12 to 84, with higher scores indicating higher intrinsic academic motivation. Nguyen and Nguyen (2019) reported that the reliability of the IM scale was greater than 0.80. In this study, the scale had good reliability and validity (α = 0.974; CR = 0.977 and AVE = 0.779) (see Table 2).

AEG: The structure of student AEG includes three dimensions: cognitive, affective and behavioural (Fredricks et al., 2004). In this study, we only assessed

students' behavioural engagement, and it was assessed by 8 items of the Student Engagement Scale of Jelas et al. (2016). All items of the scale use a 5-point Likert scale ranging from strongly disagree (1 point) to strongly agree (5 points). Sample items include “I try hard to do well in school” and “I volunteer to help with school activities such as sport day and parent day”. The total score of the 8 items ranges from 8 to 40, with higher scores indicating higher AEG. Jelas et al. (2016) reported that the reliability of the Behavioural Engagement subscale was 0.80. In this study, the scale had good reliability and validity (α = 0.874; CR = 0.901 and AVE = 0.532) (see Table 2).

Table 2. Psychometric properties of measures

Measures	**Number of items**	**Range of factor loadings**	**α**	**CR**	**AVE**
TS	2	0.875 – 0.885	0.854	0.932	0.872
IM	12	0.774 – 0.909	0.974	0.977	0.779
AEG	8	0.614 – 0.780	0.874	0.901	0.532
GPA	1	------	------	------	------

Note: TS: teacher support; IM: intrinsic motivation**,** AEG: academic engagement**,** GPA: Academic achievement.

GPA: Students' GPA was measured by a single item as follows: “Which category does your academic performance belong to in this school year?”. Response options for the question related to GPA included low ($0 \leq GPA < 2.0$), medium ($2.0 \leq GPA < 3.2$), and high ($3.2 \leq GPA \leq 4.0$).

2.3. Data analysis

Statistical analyses in the paper were performed using SPSS 20 and SMART PLS 3.9 software. The statistical analysis process was carried out in the following steps: (1) Online survey data were transferred to SPSS 20 to calculate factor loadings of items, descriptive statistics, and correlation analysis; (2) Data from SPSS 20 were transferred to SMART PLS 3.9 to analyze indicators related to reliability (α and CR) and validity (AVE) of measures; (3) Using SMART PLS, path analysis was performed to calculate the direct and indirect effects of TS on students' GPA. Direct and indirect effects were considered significant when the confidence interval (CI) did not contain the value 0 and the p value < 0.05.

3. Results

3.1. Descriptive statistics and correlation analysis

The results of descriptive statistics and correlation analysis are presented in Table 3. Accordingly, the mean scores and standard deviations of the main variables include TS: M = 6.076 (SD = 2.150), IM: M = 63.207 (SD = 13.652), AEG: M = 30.556 (SD = 4.573), and GPA: M = 2.26 (SD = 0.517).

Correlation analysis showed that TS was positively correlated with IM ($r = 0.247$, $p < 0.001$) and AEG ($r = 0.418$, $p < 0.001$); however, TS was not significantly correlated with GPA ($r = 0.072$, $p > 0.05$). IM was positively correlated with AEG ($r = 0.435$, $p < 0.001$) and GPA ($r = 0.149$, $p < 0.001$). AEG was positively correlated with GPA ($r = 0.238$, $p < 0.001$).

Table 3. Descriptive statistics and correlation analysis

Variables	M ± SD	TS	IM	AEG	GPA
TS	6.076 ± 2.150	1			
IM	63.207 ± 13.652	0.247***	1		
AEG	30.556 ± 4.573	0.418***	0.435***	1	
GPA	2.26 ± 0.517	0.072	0.149***	0.238***	1

*Note: ***: $p < 0.001$,* TS: teacher support; IM: intrinsic motivation**,** AEG: academic engagement**,** GPA: Academic achievement.

3.2. Mediation analysis

The results of the path analysis presented in Figure 2 show that the direct effects of TS on IM (B = 0.249), of IM on AEG (B = 0.360), of AEG on GPA (B = 0.231), and of TS on AEG (B = 0.328) were all statistically significant ($p < 0.001$).

The direct effects of TS on GPA (B = 0.039) and the effects of IM on GPA (B = 0.057) were not significant (p > 0.05).

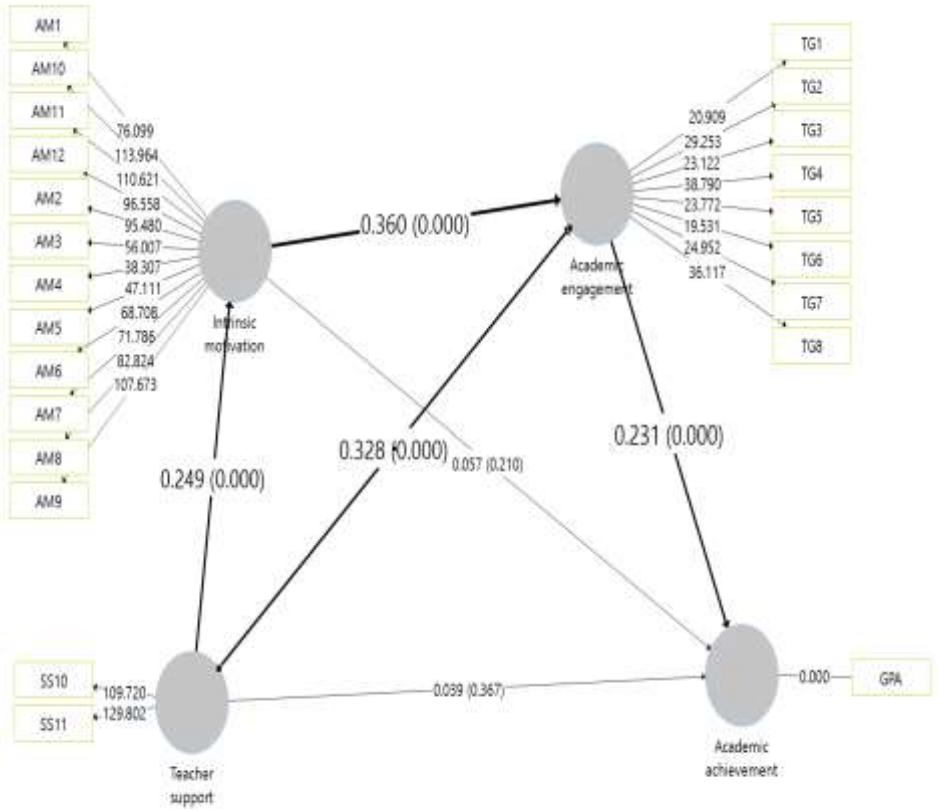

Fig. 2. Chain mediation model of IM and AEG between TS and GPA

As shown in Table 4, the effects of TS on GPA through AEG (B = 0.076, 95% CI = [0.039; 0.114]) and the chain of IM and AEG (B = 0.021, 95% CI = [0.011; 0.033]) were significant. However, the effect of TS on GPA through IM (B = 0.014, 95% CI = [-0.009; 0.036]) was not significant. The total indirect effect of TS on GPA (B = 0.110, 95% CI = [0.073; 0.151]) was significant.

Table 4. Indirect effects from TS to GPA

Indirect effects	B	SE	95% CI
TS → IM → AEG → GPA	0.021***	0.006	[0.011; 0.033]
TS → IM → GPA	0.014^{ns}	0.011	[-0.009; 0.036]
TS → AEG → GPA	0.076***	0.019	[0.039; 0.114]
Total indirect effect: TS → GPA	0.110***	0.020	[0.073; 0.151]

*Notes: ***: $p < 0.001$; ns: Not significant;* TS: teacher support; IM: intrinsic motivation**,** AEG: academic engagement**,** GPA: Academic achievement.

4. Discussion

This study used a chain mediation model to analyze the association between TS and GPA among college students in Vietnam. Results from the study confirmed that TS positively predicted GPA among college students. In addition, AEG mediated the association between TS and GPA. Moreover, IM and AEG also had chain mediation roles between TS and GPA.

Our findings suggest that TS was not positively associated with GPA among college students. Our findings are inconsistent with previous studies (Ansong et al., 2024; Peng et al., 2022; Tao et al., 2022); therefore, hypothesis 1 is rejected. According to previous studies, TS can help students satisfy their need for connection with others, increase their motivation, and AEG, increase positive emotions, and reduce negative emotions, thereby improving students' GPA (Ansong et al., 2024; L.

Huang & Wang, 2023; Hung, 2020; Karimi & Fallah, 2021; Peng et al., 2022; Ryan & Deci, 2000; Tao et al., 2022). Inconsistencies in findings regarding the link between TS and GPA may be due to differences in measurement instruments, cultural contexts, or research methods. However, this finding suggests that the link between TS and GPA may be mediated by other factors.

This study found that TS positively and significantly predicted the increase in IM of college students, which is consistent with previous studies (Chiu et al., 2023; Dietrich et al., 2015; Hung, 2020; Karimi & Fallah, 2021; Pap et al., 2021). Contrary to previous findings (Bin Abdulrahman et al., 2023; Hayat et al., 2018; Kaufman et al., 2008; Khalid & Abdul Rahman, 2023; Trevino & DeFreitas, 2014), this study found no significant relationship between IM and college students' GPA. In addition, this study found that IM did not mediate between TS and students' GPA, which does not support hypothesis H2. This finding is inconsistent with the study of An et al. (2022) on a sample of adolescents in China. Thus, although previous studies have reported that IM can enhance the impact of TS on GPA (An et al., 2022), this study did not find a mediating role of IM among college students in Vietnam. This finding may suggest that there may be other factors influencing the link between TS and GPA among college students that we have not considered.

This study also found that TS positively and significantly predicted students' AEG, which has also been confirmed in the literature (Jelas et al., 2016; Li, 2024; Sadoughi & Hejazi, 2021; Shen et al., 2024; Xu et al., 2024; Yin & Luo, 2024). At

the same time, students' engagement was associated with increases in their GPA, which has also been found in previous studies (Casuso-Holgado et al., 2013; Estévez et al., 2021; Froiland & Worrell, 2016; García-Martínez et al., 2021; Lei et al., 2018; Tannoubi et al., 2023). More importantly, we found that AEG fully mediated between TS and students' GPA, which supports hypothesis H3. This finding is consistent with the findings of previous studies (L. Huang & Wang, 2023; Peng et al., 2022; Tao et al., 2022). This suggests that TS may be related to GPA in college students, but this effect is mainly mediated by student AEG. When student AEG is high, the positive effect of TS on GPA increases significantly, whereas when student AEG is low, the effect of TS on GPA decreases or is insignificant. This result emphasizes the importance of student AEG in promoting the effect of TS on student GPA. In other words, teachers help students achieve high GPAs by encouraging and facilitating students to actively participate in learning activities. Based on previous studies, the mediating role of engagement between TS and GPA can be explained as follows: Students who feel supported by their teachers tend to exhibit positive learning attitudes and resilience (Liu et al., 2023), increased positive emotions (Ekatushabe et al., 2021; Sadoughi & Hejazi, 2021; Shen et al., 2024), high self-regulation (Yin & Luo, 2024), and high academic motivation (Xu et al., 2023, 2024), high academic self-efficacy (Alamri, 2022), and psychological need satisfaction (Xu et al., 2023, 2024), and thus, they are more likely to spend more time studying and put in effort to continuously make progress in their studies. Subsequently, students with high levels of AEG tend to be more willing to put in effort and persevere in their studies; be

positive, proud, and enthusiastic in solving academic tasks; and focus on solving academic tasks, which in turn contribute to students' GPA (García-Martínez et al., 2021). On the other hand, students with high levels of engagement are associated with a better perception of the importance of learning, which can motivate students to put in more effort in their studies and achieve higher achievements (Finn, 1989; Lei et al., 2018).

We also found that IM and AEG chain mediated between TS and GPA among Vietnamese college students, which supports hypothesis H4. This suggests that TS may indirectly increase college students' GPA through the combination of two mediating factors, including IM and AEG. Students with high levels of TS can only increase their GPA if they have high IM to learn and high AEG. Previously, there was also evidence of a positive relationship between TS and IM (Chiu et al., 2023; Dietrich et al., 2015; Hung, 2020; Karimi & Fallah, 2021; Pap et al., 2021), between IM and engagement (Mohamed Mohamed Bayoumy & Alsayed, 2021; Pan, 2023; Siu et al., 2014; Suárez et al., 2019; Zang et al., 2022), and between engagement and GPA (Casuso-Holgado et al., 2013; Estévez et al., 2021; Froiland & Worrell, 2016; García-Martínez et al., 2021; Lei et al., 2018; Tannoubi et al., 2023). Based on previous findings, we explain this complex relationship as follows: (1) TS creates a positive learning environment and encourages students to learn, thereby contributing to enhancing students' IM (Karimi & Fallah, 2021; Ryan & Deci, 2000). In addition, positive relationships with teachers can promote students' IM, helping them pay

attention and complete learning tasks better (Federici & Skaalvik, 2014; Pap et al., 2021). (2) Students with high levels of IM often show attention in class and are active in learning activities (Acosta-Gonzaga, 2023); at the same time, they also invest more time and effort in their learning activities (Pan, 2023; Suárez et al., 2019). (3) Students with high levels of AEG have a better perception of the importance of learning (Finn, 1989; Lei et al., 2018), have high levels of vigour, absorption, and dedication when solving learning tasks, thereby promoting increased GPA (García-Martínez et al., 2021). Finding the chain mediating effect of IM and AEG between TS and GPA among college students is a novel point of the study, which has not been explored in previous studies.

With a new research context (Vietnam) and a new research subject (college students), this study found a fully mediating role of IM and AEG between TS and AEG in college students in Vietnam. The findings of this study not only provide further insights into the psychological mechanisms related to TS and GPA but also suggest measures to enhance students' GPA. The results of this study emphasize the role of IM and AEG between TS and GPA. According to the findings of this study, to improve students' GPA, measures should be strengthened on TS, IM, and AEG. Specific measures that teachers can take include creating a safe and open learning environment to encourage student AEG; promoting students' IM to learn through engaging lesson design; linking learning content to students' interests and learning goals; encouraging students to actively participate in academic activities; monitoring

and understanding each student to provide timely and appropriate individual guidance and support; and building positive, close, and trusting relationships with students.

Despite its important theoretical and practical contributions, the study still has several limitations that should be considered in future research. Limitations of our study include its cross-sectional design, convenience sampling, and unbalanced sample size by gender and grade level. These limitations may make it difficult to determine the exact direction of relationships, reduce the generalizability of the findings, and bias the results. Therefore, a longitudinal design study with random sampling and a balanced sample may be needed in the future to overcome the mentioned limitations. Additionally, there may be other mediating factors between TS and GPA such as academic self-efficacy and homework behavior, academic emotions, or mental health problems, which we were unable to clarify. Therefore, future studies may consider examining other mediating factors that mediate the relationship between TS and GPA.

Conflict of Interest Statement: None

Informed Consent: Informed consent was obtained from all individual participants included in this study.

Ethical Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee.

Data Availability Statement: Research data are not shared.

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