The Role of Student Engagement in the Relationship of Intrinsic Motivation and

Academic Achievement

Rebeka Ambrožič

S4745256

Department of Psychology, University of Groningen

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Supervisor: Dr. Prof. Miguel Garcia Pimenta

Second evaluator: Haris Psaros

In collaboration with: Inga Embovica, Lyanda Klaus, Klára Oprsalová, Hanna Specht,

Lavinia Whitney

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Abstract

In light of the recent fall in academic achievement, enhancing their level is crucial for students' future. Prior research has established that intrinsic motivation predicts students' academic achievement, yet the underlying mechanisms remain ambiguous. Intrinsic motivation was shown to indicate student engagement, which further forecasts academic achievement. Thus, this paper hypothesized the mediating role of student engagement between intrinsic motivation and academic achievement. We utilized an archival cross-sectional study based on a convenience sample of 653 University of Groningen students, predominately female and Dutch. Student engagement and intrinsic motivation were measured via self-report measures, whereas grade point average quantified academic achievement. A mediation analysis revealed that intrinsic motivation predicted student engagement, which did not predict academic achievement. The indirect relation of intrinsic motivation to academic achievement through student engagement was non-significant, hence student engagement did not mediate this relationship. However, intrinsic motivation directly predicted academic achievement when accounting for student engagement. Considering the homogeneity of the used sample, the findings show limited generalizability. Nonetheless, this study is the first to examine the proposed mediation, making future replications imperative to validate the current findings. Nonetheless, the paper hints at the intrinsic motivation's potential to boost students' academic achievement in educational interventions.

Keywords: intrinsic motivation, student engagement, academic achievement, mediation

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The determinants influencing university students' academic achievement are extensively debated. *Academic achievement* is a collection of "performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically university" (Steinmayr et al., 2015, p. 1). In the recent review by Richardson et al. (2012), 41 constructs were significantly correlated with *grade point average* (GPA), a measure of academic achievement, with some being biological sex, age, different personality traits, and motivational factors. Despite the various established predictors of academic achievement, few studies delve into the underlying mechanisms of these relations. Investigating the possible intermediate variables between academic achievement and its predictors is crucial to forming interventions that boost academic achievement. Such interventions are essential since academic achievement is one of the students' vital factors in guaranteeing a successful future. According to a recent study, the students with the class' top 25% GPA showed a 10% elevated employability (Bartolj & Polanec, 2021). In line with this finding, it has been suggested that academic achievement is a strong predictor of future income, with an additional consequence being higher life satisfaction (Lv et al., 2016; Oehrlein, 2009). With university students' academic achievement declining in the last few years, as seen in progressively lower graduation rates, devising new interventions to boost it is imperative (National Student Clearinghouse Research Center, 2024). Assessing the factors that predict academic achievement is of immense value, as it promotes the search for the fundamental mechanisms behind the relations, in addition to novel interventions to increase students' academic achievement and ensure them a prosperous future (Lv et al., 2016; Oehrlein, 2009).

Among the discovered predictors of academic achievement, motivation elements emerged as one of those most associated with academic achievement (Richardson et al., 2012). Different motivation factors provide many reasons why a student participates in academia. One of the most famous theories investigating these factors is the *self-determination theory* (SDT) (Ryan & Deci, 2000). SDT posits that there exist two main types of motivation. *Intrinsic motivation* is defined as the willingness to perform a particular task due to the task being inherently satisfactory, while *extrinsic motivation* is related to the motivation to perform some action in order to obtain a favorable future outcome (Ryan & Deci, 2000). Among the motivation factors, intrinsic motivation is among the most significant predictors of academic achievement (Richardson et al., 2012). Many studies have indicated that intrinsic motivation results in optimal task performance, assumingly contributing to higher academic achievement, reflected in a small but significant positive association between intrinsic motivation and academic achievement (Khalaila, 2015; Richardson et al., 2012). It is also important to note that compared to other motivational factors such as extrinsic motivation, locus of control, and pessimistic attributional style, intrinsic motivation exhibited a superior positive correlation to academic achievement, making it one of the most optimal motivational predictors of academic achievement (Khalaila, 2015; Richardson et al., 2012). Given these findings, the present research paper will utilize intrinsic motivation concerning academic achievement.

We must examine intermediate factors to explain the relationship between intrinsic motivation and academic achievement. By analyzing these factors, the underlying processes of the relationship between intrinsic motivation and academic achievement can be discovered, which will aid the interventions to increase academic achievement in students. Reeve (2012) proposed student engagement as an intermediate variable between general motivation and academic achievement. On the contrary, no research has identified student

engagement as a possible mechanism of relationship between intrinsic motivation and academic achievement, which will be the focus of the current study.

Student engagement is an active involvement in academic learning and tasks (Wellborn, 1992). It contains tasks such as participating in discussions, using cognitive strategies while learning in the classroom, or showing happiness when receiving a desired exam mark (Froiland & Worrell, 2016; Lei et al., 2018). Student engagement is a multifaceted construct of three domains, specifically cognitive, emotional, and behavioral engagement (Lei et al., 2018). *Cognitive engagement* mainly considers the utilization of self-regulation and mental techniques, while *emotional engagement* includes students' reactions to the academic environment (Fredricks et al., 2004). Lastly, *behavioral engagement* involves the amount of participation in academic tasks that students portray (Lei et al., 2018). Similarly, student engagement is a tripartite construct comprising three subtypes (Schaufeli, 2017). *Absorption* is termed as being entirely concentrated while studying and finding it difficult to detach from it, whereas *dedication* represents being deeply committed to learning and sensing enthusiasm and challenge (Schaufeli, 2017). *Vigor* refers to great willingness and mental resilience while studying (Schaufeli, 2017). Some studies hint at the similarity between absorption and cognitive engagement, dedication and emotional engagement, and vigor and behavioral engagement constructs. However, there is a lack of research on this topic (Schauefeli, 2017). Therefore, this paper will utilize these constructs separately. While student engagement seems vital for students' academic achievement, it is essential to distinguish it from a similar construct of intrinsic motivation.

Both student engagement and intrinsic motivation are similar in encouraging involvement in academia and its outcomes. However, there appear to be some differences between the two variables. Student engagement is more objective and observable, whereas intrinsic motivation tends to be more individualized, psychological, and subjective (Reeve,

2012). In other words, intrinsic motivation is an antecedent internal predictor of visible behavior, i.e., student engagement (Thomas, 2009). Notably, intrinsic motivation has been identified as one of the strongest predictors of student engagement, showing a small positive correlation based on a recent meta-analysis in a sample of nurses (Zeng et al., 2022).

In addition to intrinsic motivation, student engagement has been reportedly associated with academic achievement (Lei et al., 2018). Such a finding was reflected in a small positive correlation (Lei et al., 2018). Previous studies showed that students with higher engagement also portrayed higher exam scores (Tannoubi et al., 2023). Wäschle et al. (2014) propose an underlying process for the relationship between student engagement and academic achievement, where student engagement elevates academic achievement, further heightening student engagement, making the pattern repeat to create a virtuous learning circle. It is important to note that Wäshle et al. (2014) refer to student engagement indirectly through one of its main antecedents, self-efficacy (Tsao, 2021). The proposed virtuous learning cycle thus elucidates student engagement's role in predicting academic achievement (Crossan et al., 2003).

Ultimately, the paper aims to investigate the relationship between intrinsic motivation, student engagement, and academic achievement. Existing research indicated that intrinsic motivation is positively associated with academic achievement. Furthermore, intrinsic motivation positively correlated with student engagement, which was, in turn, positively associated with academic achievement. Based on the described observations, the following research question can be raised: "Does student engagement mediate the relationship between intrinsic motivation and academic achievement?". Thus far, it has been proposed that student engagement may mediate the relationship between motivation and academic achievement (Reeve, 2012). However, no past research has tested the mediation of student engagement in the relation between intrinsic motivation and academic achievement, indicating a research

gap. Investigating the role of student engagement in the relationship between intrinsic motivation and academic achievement might shed light on a previously unknown mechanism. Discovering such a mechanism could widen the scope of theoretical knowledge and aid in developing educational interventions with the potential to elevate academic achievement. For instance, if intrinsic motivation predicts academic achievement through student engagement, this could urge researchers to develop interventions focused on boosting students' engagement to maximize academic achievement. Therefore, this paper aims to test the following hypothesis.

H1: Student engagement acts as a mediator on the association between intrinsic motivation and academic achievement, where intrinsic motivation is positively linked with student engagement, which is then positively related to academic achievement.

In addition to the confirmatory hypotheses, the intervening variables in the association between student engagement and academic achievement will be explored in case of a significant correlation between intervening variables and each factor. Past research indicated biological sex has been found to influence student engagement as well as academic achievement, where females were found to achieve greater levels of both academic achievement and student engagement in comparison to males (King, 2016; Maelekanyo & Takawira, 2015; Wrigley-Asante et al., 2023). It is paramount to detect intervening factors, such as sex, and control for them while exploring student engagement in intrinsic motivation-academic achievement association to gain a comprehensive understanding of the proposed link.

Methods

Participants

This study used a cross-sectional research design with a convenience sample of 742 psychology students at the University of Groningen in the Netherlands. Out of these, 89

participants were excluded from the sample in sequential steps, firstly because they did not complete the survey fully ($N= 74$), failed the instructed response items ($N= 12$), admitted to not answering honestly ($N= 2$), or reported insufficient English level ($N= 1$). The final sample ($N= 653$) was comprised of 25.3% of men ($N=165$), 74.4% of women ($N= 486$), and 0.3% of participants who remained undisclosed ($N= 2$). The mean age was 20, ranging from 17 to 35, with a standard deviation 2.2. Nationalities were distributed as follows: 52.5% Dutch ($N= 343$), 21.4% German ($N= 140$), and 26.0% other ($N= 170$). Considering the International Standard Classification of Education (ISCED) classification system, 87.4% of participants ($N= 571$) achieved upper secondary education or high school, 0.9% post-secondary vocational education ($N= 6$), 1.7% short-cycle higher education ($N= 11$), 5.1% Bachelor ($N= 33$), 0.3% Master's ($N= 2$) and 4.6% was unsure of their education ($N= 30$) (UNESCO Institute for Statistics, 2012). Most participants, i.e., 77.6% ($N= 507$), were a part of the SONA practicum, a pool of first-year students at the University of Groningen participating for course credit. In addition, 7.4% were second-year students ($N= 48$), and 15.0% were third-year students ($N= 98$). In the current sample, 70.3% were students ($N= 459$), 29.6% were working students ($N= 193$), and 0.2% reported another profession ($N= 1$).

Materials

The following measures were used to conceptualize the variables of our study.

Intrinsic Motivation

The variable of intrinsic motivation was assessed by utilizing items from the subscales of the 28-item self-perceived Academic Motivation Scale (AMS), namely the intrinsic motivation to know, experience stimulation, and motivation toward accomplishment (Vallerand et al., 1989). Since we investigated intrinsic motivation as a unitary concept, all items of the three mentioned subscales were incorporated, resulting in 12 items. We summed the scores of the subscales into one score, which was averaged. Such inclusion of the final

score was supported by Kusurkar et al. (2013) and Vallerand et al. (1992), as seen in an adequate factorial validity in the latter study. The scale asked why participants attended university and presented them with different statements. An example of an item was "Because I experience pleasure and satisfaction while learning new things''. The participants were required to rate statements using seven-item Likert scales, spanning from 1 (*does not correspond at all*), 2 (*corresponds very little*), 3 (*corresponds a little*), 4 (*corresponds moderately*), 5 (*corresponds enough*), 6 (*corresponds a lot*) and finally, 7 (*corresponds exactly*). In the current sample, the items used for intrinsic motivation in AMS demonstrated an acceptable internal consistency (α= .85).

Student Engagement

We measured student engagement using all items of the nine-item self-report scale, The Utrecht Work Engagement Scale for Students (UWES-9S) by Carmona–Halty et al. (2019). The questionnaire included the three aspects of student engagement: vigor, dedication, and absorption. Despite its three-factor composition, it was not recommended to use separate scores because they are highly correlated, meaning that they might measure the same construct (Schaufeli, 2017). Conversely, UWES-9S portrayed appropriate psychometric properties when considered a composite score. Therefore, the scores of all the items were summed up and then averaged. The participants were provided with statements such as "When I'm doing my work as a student, I feel bursting with energy." Their responses were measured on a seven-item Likert-type scale with the following scores: 0 (*never*), 1 (*almost never or a few times a year or less*), 2 (*rarely or once a month*), 3 (*sometimes or a few times a month*), 4 (*often or once a week*), 5 (*very often or a few times a week*) and 6 (*always or every day*). The UWES-9S demonstrated appropriate internal reliability in our sample (α=.91).

Academic Achievement

To measure academic achievement, we used the participants' GPA scores, which we obtained by accessing their official records in the current study year. The GPA ranged from 1 to 10 (1 being the lowest grade and 10 being the highest grade, with a minimum passing mark of 5.5).

Procedure

We utilized archival data from 2023, which included the survey obtained via an online English questionnaire in Qualtrics. The Faculty of Behavioural and Social Sciences ethical committee approved the study at the University of Groningen. The participants were recruited through advertisements on campus and social media platforms, such as WhatsApp, and via the first-year SONA practicum pool. All participants' involvement in this research was voluntary, and they had the right to refuse to participate at any time. Furthermore, participants in the SONA practicum pool received SONA credits as compensation, while others did not receive any compensation for their participation. The survey took approximately 20 minutes to complete. Before the survey, participants were informed about the study's goal, the procedure, and the consequences of participating in this study. Furthermore, they were assured about the confidentiality of their data and their right to informed consent.

Participants responded to several survey components, starting with demographic questions regarding their study year, biological sex, nationality, and highest completed level of education. The next part of the survey focused on cognitive, motivational, and behavioral aspects of academic achievement, including student engagement and intrinsic motivation, via the previously mentioned two questionnaires. In addition to our questionnaires, the archival data included other scales, such as the Five-Dimensional Curiosity Scale (Kashdan et al., 2018). Subsequently, the students were asked some additional questions about medical diagnoses, specifically if they were diagnosed with a psychological or brain disorder in the

past six months. Furthermore, they were asked about their medication and substance use in the past six months. At the end of the survey, the participants were asked to indicate if they had completed the study truthfully and with a thorough understanding of the English language, and they were allowed to leave a comment.

Design and Statistical Data Analysis

We employed a mediation analysis via IBM Statistical Package for the Social Sciences (SPSS), version 29, to analyze the obtained data. In the model, intrinsic motivation acted was an independent variable, academic achievement was a dependent variable, and student engagement was a mediator variable (see Figure 1).

We performed direct mediation analysis via PROCESS using the bootstrap method with a 95% confidence interval (Hayes, 2023). Moreover, all analyses used a two-tailed significance ($\alpha = .05$). According to Cohen (1988), a correlation until .29 represented a small association, a moderate correlation from .30 to .49, and a large correlation from .50 or more. The guidelines for the effect size were as follows: small effect size was up to .49, medium effect size from .50 until .79, and large from .80 and above (Cohen, 1988). The effect sizes were reported for three mediation effects. As illustrated in Figure 1, the indirect *ab* effect represented the relationship between intrinsic motivation and academic achievement through student engagement, which required 5000 bootstrap resamples. Path *a* indicated a correlation between intrinsic motivation and student engagement, whereas path *b* represented an association between student engagement and academic achievement. Secondly, the direct effect of the link between intrinsic motivation and academic achievement was presented via path *c'*. Lastly, the total effect of path *c*, considered both indirect and direct paths.

Figure 1

Mediation Model With Student Engagement as a Mediator in the Relationship Between

Intrinsic Motivation and Academic Achievement
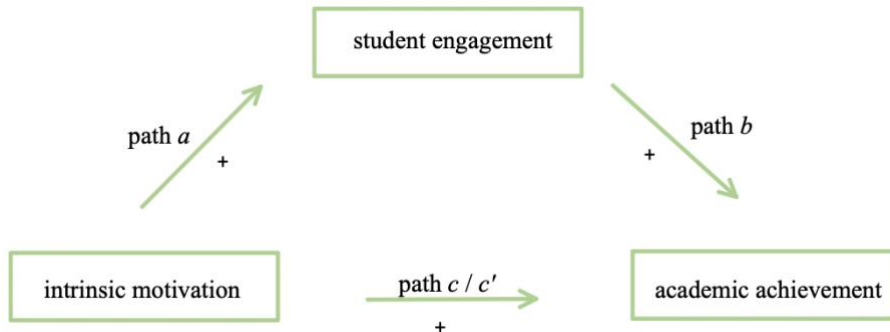
Note. The plus sign (+) indicates a predicted positive correlation.

Results

Before the start of the analysis, the data set was reviewed. Through missing value analysis, some missing data on GPA was detected. Upon exploration, the participants' data on GPA scores were missing (*N*= 58) for various reasons, such as lost data or participants not giving consent. As indicated by a significant Little's MCAR test, the data turned out to be missing not completely at random ($\chi^2(2, 653)= 16.16$, *p*< .001). Approximately 10% of the GPA data was missing. Given these observations, a multiple imputation method could be implemented to replace the missing data accurately based on the present data. Significant predictors of the GPA scores obtained in linear regression, namely, age and mean social curiosity scales from the Five-Dimensional Curiosity Scale, were utilized to perform imputation (Kashdan et al., 2018). Ten imputation samples were generated to replace each missing GPA score from 1 to 10. The pooled mean of all imputed samples was 6.8, accurately mimicking the mean of the existing GPA scores. The imputation sample that most closely matched the original mean was used as a final data set.

Before further data investigation, the assumption checks were performed (see Appendix A). Homoscedasticity was tested graphically by observing a scatterplot of

standardized residuals plotted against standardized predicted values, which was validated

through a random scatter around the *x*-axis. Next, normality was assessed by observing a P-P

plot of the predictor, outcome, and mediating variable, which all showed a straight line,

confirming the assumption. The linearity assumption was based on significant linearity and

non-significant deviation from linearity. The independence of residuals was evident in the

Durbin-Watson statistic approximating two. Additionally, there was a non-significant

interaction between the predictor and mediator. Furthermore, a heteroscedasticity consistent

regression estimate by Davidson-MacKinnon was utilized, as Cribari-Neto et al. (2005)

recommended. Moreover, the confirmed multivariate normality seen in the graphical

assessment of the Chi-square vs. Mahalanobis distance plot performed after Arifin (2015)

showed that previously conducted Little's MCAR test can be meaningfully interpreted. Once

the assumption checks were validated, the associations between variables could be assessed.

  The correlations and descriptive statistics of intrinsic motivation, student engagement,

GPA, and demographic variables were noted in Table 1. The intrinsic motivation portrayed a

small positive relation with academic achievement and a large positive association with

student engagement. Moreover, intrinsic motivation showed a small positive and a small

negative correlations with nationality and stimulant substance use, respectively. Academic

achievement exhibited a small positive relation with student engagement and age. There was

a small positive correlation between age and biological sex and between mental health

diagnoses and stimulant medication use. Furthermore, education presented a small positive

association with age. Diagnosis of mental disorders portrayed a small negative association

with biological sex. Each student engagement subscale showed large positive correlations

with intrinsic motivation and the combined student engagement. Vigor and absorption

positively correlated with academic achievement, whereas dedication exhibited a non-

significant association with the same variable. Dedication portrayed a small positive

association with biological sex. Absorption further depicted a small positive correlation with nationality. Both absorption and dedication showed a large positive association with vigor, which was also observed between absorption and dedication. The remainder of the associations were non-significant.

Table 1

Pearson Correlations (r) With Mean, Standard Deviations (SD), and Sample Size (N) of Analyzed Variables

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. IM	-												
2. AA	.13***	-											
3. Student Engagement	.62***	.11**	-										
4. Sex	.06	.03	.02	-									
5. Age	.07	.08*	.02	-.20***	-								
6. Education	.05	.07	.02	.03	.20***	-							
7. Nationality	.10**	.06	.06	.06	-.06	.03	-						
8. SMED	-.03	.03	-.12	-.09	-.10	.08	-.14	-					

Table 1 (continued)

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
9. SSUB	- 0.09*	-.05	.02	-.05	.04	-.07	.02	.06	-				
10. Diagnosis	-.00	.03	-.06	-.18*	-.11	-.04	-.14	.16*	.08	-			
11. Vigor	.52***	.13**	.88***	-.05	.00	-.01	.07	-.11	-.03	-.03	-		
12. Dedication	.56***	.07	.87***	.10*	-.01	.05	-.03	-.11	.05	-.07	.61***	-	
13. Absorption	.58***	.09*	.92***	.01	.05	.01	.13**	-.10	.03	-.06	.73***	.70***	-
Mean	4.7	6.8	4.7	-	20.3	-	-	-	-	-	4.2	5.2	4.5
SD	0.9	1.2	0.9	-	2.2	-	-	-	-	-	1.1	1.0	1.1
N	653	653	653	653	653	653	653	170	650	170	653	653	653

Note. IM= intrinsic motivation, AA= academic achievement, SMED= stimulant medication use, SSUB= stimulant substance use

* $p < .05$ two-tailed level, ** $p < .01$ two-tailed level, *** $p < .001$ two-tailed level.

To investigate if student engagement mediated the relationship between intrinsic motivation and academic achievement, it was crucial to establish the degree of similarity of the possible student engagement measures. As shown in Table 1, the three student engagement subscales showed strong positive correlations between one another. In addition, they portrayed a high shared variance of the average combined student engagement score, where vigor showed 77%, dedication contained 75%, and absorption indicated 84% variance, indicating convergent validity. They seemed to measure similar student engagement constructs. Consequently, the combined student engagement was the most suitable for mediation analysis.

Analysis of *H1*

The primary analysis addressed whether student engagement mediated the association between intrinsic motivation and academic achievement. Initially, we tested the mediation assessment with and without the missing data to confirm whether the computation of the absent data appropriately matched our original sample. There were no differences in outcome between the two analyses, prompting us to use the imputed data for further investigation.

The results of the mediation analysis can be viewed in Table 2. Intrinsic motivation significantly predicted student engagement (path *a* in Figure 1), which did not significantly result in academic achievement (path *b* in Figure 1). The indirect effect of intrinsic motivation on academic achievement through student engagement was not significant, as evidenced in the confidence interval containing zero (*AB*= .03, *BootSE*= 0.04, *CI* [-0.05, 0.11], ab_{cs}= .03). Conversely, the total effect of intrinsic motivation on academic achievement, irrespective of student engagement, was significant (R^2= .13, *t*= 3.50, *p*=.000, c_{cs}= .13). Stated differently, when intrinsic motivation increased for one unit, academic achievement enlarged for .17 units regardless of student engagement. In sum, the research hypothesis was rejected.

Table 2

Simple Mediation Analysis With Student Engagement as a Mediator in the Relationship

Between Intrinsic Motivation and Academic Achievement

Predictor		Student Engagement				AA		
		B (SE)	*p*	95% *CI*		*B (SE)*	*p*	95% *CI*
IM	*a*	.63 (0.03)	.000	[0.57, 0.68]	*c'*	.14 (0.06)	.027	[0.02, 0.26]
					c	.17 (0.05)	.000	[0.07, 0.26]
Student Engagement					*b*	.05 (0.07)	.436	[-0.08, 0.18]

Note: IM= intrinsic motivation, AA= academic achievement, SE= standard error, CI= confidence interval, paths *a*, *b*, *c*, *c'* are observed in Figure 2.

Exploratory Analysis

To attempt to explain why student engagement did not mediate the relationship between intrinsic motivation and academic achievement, further analyses were performed. Since age was significantly associated with the outcome variable, it was utilized as a covariate in the mediation model (view Figure 2). This decision was further supported by an existing study of high school students, which indicated that older students attained higher academic achievement, making it a variable worth controlling for (Nam, 2014). Contrary to previous studies, our data did not show a significant influence of biological sex on GPA and student engagement (King, 2016; Maelekanyo & Takawira, 2015; Wrigley-Asante et al., 2023). Therefore, biological sex was not controlled for when considering the influence of student engagement on intrinsic motivation and academic achievement.

Figure 2

Updated Mediation Model With Student Engagement as a Mediator in the Relationship

Between Intrinsic Motivation and Academic Achievement With Age as a Covariate
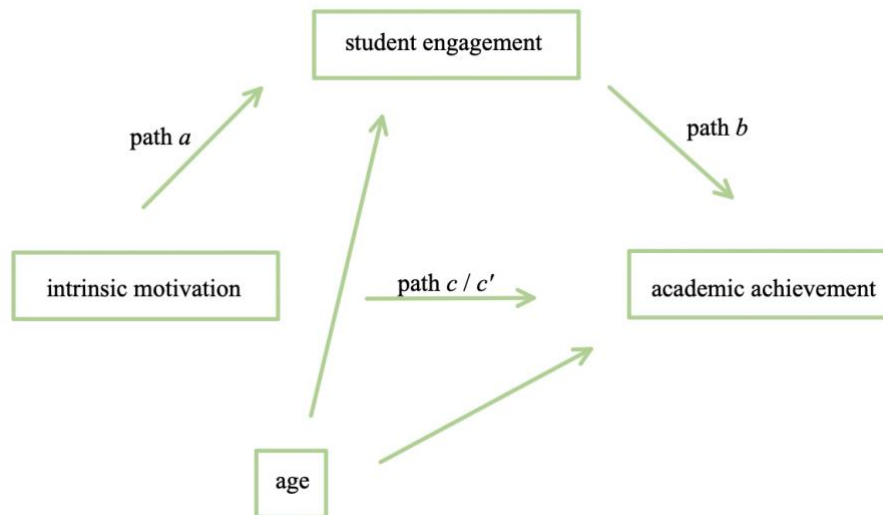
The mediation analysis showed intrinsic motivation as a significant predictor of student engagement (path *a* in Figure 2), while student engagement was a non-significant predictor of academic achievement (path *b* in Figure 2) (view Table 3). Furthermore, the indirect effect of intrinsic motivation on GPA was not significant, as portrayed in the confidence interval containing zero (*AB*= .034, *BootSE*= 0.04, *CI* [-0.05, 0.11], ab_{cs}= .03). Nevertheless, there was a significant total effect between intrinsic motivation and academic achievement while controlling for student engagement and age (R^2= .15, *t*= 3.36, *p*= .002, c_{cs}= .13). The overall relationship between the three variables indicated that for each additional unit in intrinsic motivation, academic achievement elevated by .16 units irrespective of participants' age or student engagement. The mediation analysis results did not differ when considering covariate age compared to the primary analysis.

Table 3

Simple Mediation Analysis With Student Engagement as a Mediator in the Relationship Between Intrinsic Motivation and Academic Achievement

with Age as a Covariate

Predictor		Student Engagement				AA		
		B (SE)	*p*	95% *CI*		*B (SE)*	*p*	95% *CI*
IM	*a*	.63 (0.03)	.000	[0.57, 0.69]	*c'*	.13 (0.06)	.040	[0.00, 0.25]
					c	.16 (0.05)	.001	[0.07, 0.25]
Student Engagement					*b*	.06 (0.07)	.398	[-0.07, 0.18]
Age		-.01 (0.02)	.443	[-0.04, 0.02]		.04 (0.02)	.074	[-0.00, 0.08]

Note: IM= intrinsic motivation, AA= academic achievement, SE= standard error, CI= confidence interval, paths *a*, *b*, *c*, *c'* are observed in Figure

2.

We performed a further exploratory analysis to determine why path *b* was non-significant, contributing to the non-significant indirect effect of student engagement in intrinsic motivation-academic achievement relation (see Table 2). One reason for the non-significant path *b* might have been mediation pathway obfuscation. As seen in Table 1, there was a large positive correlation between student engagement and intrinsic motivation, making it difficult to disentangle the effects of each variable on academic achievement. Hence, the simultaneous presence of intrinsic motivation and student engagement in the mediation model may have masked the contribution of student engagement on academic achievement, making path *b* non-significant (view Table 2). By mitigating the overlap between the two variables, the confounding effects could be lowered, allowing for a more precise testing of the mediation model. In essence, this approach could assist in interpreting whether student engagement mediates the relation between intrinsic motivation and academic achievement. To reduce the overlap in variables, a student engagement subscale that showed the lowest correlation with intrinsic motivation was used, which was vigor. Despite the high shared variance between the student engagement subscales, testing whether vigor shows a different indirect effect in the mediation model was of great importance.

As presented in Table 4, intrinsic motivation significantly predicted vigor (path *a* in Figure 2), albeit the prediction was slightly lower than that of the first analysis. Vigor had a non-significant impact on academic achievement (path *b* in Figure 2). The relation between vigor and academic achievement marginally, however non-significantly, increased compared to the previous analysis. Moreover, the indirect effect of intrinsic motivation on academic achievement was not significant (*AB*= .06, *BootSE*= 0.030, *CI* [-0.00, 0.12], ab_{cs}= .043). However, it was closer to being significant compared to the primary mediation model (see Figure 1). Lastly, there was a significant total effect between intrinsic motivation and academic achievement while controlling for age and vigor (R^2= .15, *t*= 3.36, *p*= .001, c_{cs}=

.13). For each additional unit in intrinsic motivation, academic achievement increased by .16 units regardless of participants' age or vigor. Despite the subtle changes, no significant differences were observed from the primary mediation analysis when considering the influence of vigor compared to the combined student engagement in the intrinsic motivation-academic achievement relation. Therefore, student engagement, specifically its subscale vigor, did not mediate the association between intrinsic motivation and academic achievement.

Table 4

Simple Mediation Analysis With Vigor as a Mediator in the Relationship Between Intrinsic Motivation and Academic Achievement with Age as a Covariate

Predictor		Vigor				AA		
		B (*SE*)	*p*	95% *CI*		*B* (*SE*)	*p*	95% *CI*
IM	*a*	.59 (0.04)	.000	[0.52, 0.67]	*c'*	.11 (0.05)	.053	[-0.00, 0.21]
					c	.16 (0.05)	.001	[0.07, 0.25]
Vigor					*b*	.09 (0.05)	.073	[-0.00, 0.19]
Age		-.02 (0.02)	.375	[-0.05, 0.02]		.039 (0.02)	.065	[-0.00, 0.08]

Note: IM= intrinsic motivation, AA= academic achievement, SE= standard error, CI= confidence interval, paths *a, b, c, c'* are observed in Figure 2.

Discussion

This paper hypothesized that student engagement might play a role in the relation between intrinsic motivation and academic achievement. There was a weak relation between intrinsic motivation and academic achievement, as well as the student engagement and academic achievement. In addition, the students with high intrinsic motivation tended to portray high student engagement levels consistently. Our analysis showed that high intrinsic motivation persistently increased student engagement. However, student engagement did not

forecast students' level of academic achievement. Furthermore, intrinsic motivation directly affected students' academic achievement scores, irrespective of student engagement. However, when student engagement was taken as an intermediate step, intrinsic motivation no longer predicted students' academic achievement. To answer the research question, student engagement was not a mechanism underlying the relationship between intrinsic motivation and academic achievement, as intrinsic motivation directly impacted academic achievement in university students regardless of student engagement.

Some of the findings supported our expectations, whereas several also diverged from the predictions of the retrospective research. The path of intrinsic motivation to student engagement showed that students with high intrinsic motivation tended to consistently possess a higher level of student engagement. On the other hand, Zeng et al. (2022) observed a small relation between intrinsic motivation and engagement. The possible diversion of results may lie in the difference of participants, where the mentioned paper based their findings on a group of nurses, whereas the current study used students. This indicates that nurses' intrinsic motivation may impact their engagement less than those of students. Regarding the link between student engagement and academic achievement, the small relation between student engagement and academic achievement in the current research opposed the findings of Lei et al. (2018), who discovered a strong relation between the two. A possible explanation for the disparity is that Lei et al. (2018) considered factors that may influence the relation between student engagement and academic achievement, such as culture, which was not utilized in our study. Considering the indirect link from intrinsic motivation to academic achievement via student engagement, the findings differed from those of Reeve (2012), who discovered a salient intermediate role of student engagement in the mentioned relation. Upon reviewing the literature, it becomes apparent that this is likely since the author utilized a different conceptualization of student engagement. Specifically, Reeve (2012) included a

fourth factor of student engagement, agentic engagement, which was not represented as part of student engagement in our study. Reeve (2013) and Reeve and Tseng (2011) have portrayed the unique contribution of agentic engagement to academic achievement. This was true even while controlling for the other student engagement subtypes, meaning that agentic engagement may be the reason for the salient influence of combined student engagement in the motivation-academic achievement finding. Moreover, Reeve's (2012) paper utilizes general motivation, whereas ours exclusively focuses on intrinsic motivation. The precision of intrinsic motivation compared to general motivation might have led to different influences on student engagement in the relationship, highlighting the importance of researching precise motivation factors. By emphasizing a more specific component of general motivation, our study enabled a more complex investigation of the proposed influence of student engagement in the link between intrinsic motivation and academic achievement. Lastly, when considering the direct connection between intrinsic motivation and academic achievement, intrinsic motivation made a small but notable contribution to academic achievement. This result backs up the self-determination theory since intrinsic motivation appears to directly predict academic achievement (Richardson et al., 2012).

Despite the attempts to further answer the research question by controlling for the influence of age and considering vigor in place of student engagement in the exploratory analyses, intrinsic motivation did not indirectly predict academic achievement through student engagement. It was seen that regardless of age, student engagement did not underline the relation between intrinsic motivation and academic achievement. An explanation of this lies in past studies reporting an age-academic achievement relation only until high school thereby the effect of age might not be as observable in university students (Nam, 2014). Additionally, considering vigor as an intermediate step between intrinsic motivation and academic achievement did not reveal its distinct influence in this relation. This can be comprehended by

the high overlap of the three student engagement subtypes of the currently used measure, meaning that it may not be sensitive enough to capture an independent engagement type, i.e., vigor.

Several plausible explanations exist for the absence of intrinsic motivation's indirect influence on academic achievement via student engagement. One possible reason is that student engagement did not predict academic achievement in our sample, which can be comprehended by considering the method of reporting student engagement. Lei et al. (2018) note that teacher-reported student engagement is more strongly predictive of academic achievement than the student-reported one employed in our study. In other words, students may inaccurately judge their student engagement compared to the teacher's observations. Thus, the self-reported student engagement measure in the current study may not appropriately anticipate the students' academic achievement, possibly elaborating on the inability of student engagement to predict academic achievement. When further considering the lack of student engagement's predictability in academic achievement, a more complex interaction may exist between student engagement and academic achievement than anticipated. It is plausible that student engagement is not the sole mechanism of how intrinsic motivation predicts academic achievement and other unknown phenomena may be involved. By discovering these constructs, a more complete model can be formed of how student engagement influences the relation between intrinsic motivation and academic achievement, and our research question can be more comprehensively answered. Irrespective of the lack of influence of student engagement in the mentioned relation, the results still emphasize essential theoretical and practical implications.

This paper is the first to bridge the knowledge gap regarding the impact of student engagement on the intrinsic motivation-academic achievement relation, serving as a baseline knowledge on the topic. Despite dismissing the indirect influence of intrinsic motivation

through student engagement on academic achievement, intrinsic motivation alone explains at least a small portion of academic achievement. This finding contributes to the knowledge base of the previously established link between intrinsic motivation and academic achievement. Enhancing intrinsic motivation may be one of the key factors resulting in improved academic achievement. With the recent decline in academic achievement, boosting students' academic achievement is critical (National Student Clearinghouse Research Center, 2024). Educational programs that foster intrinsic motivation in academia, such as increasing mastery-oriented goals via mastery-focused canvas boards, may be an opportunity to improve university students' academic achievement (Franken, 2023). By elevating their academic achievements, students can attain better-paying job positions, guaranteeing them a higher financial status, a critical life aspect. Despite the prominence of the study results, there are also crucial weaknesses that require examination.

The study identifies three critical limitations. Firstly, the high relation of intrinsic motivation to student engagement leads to the conceptual issue of the similarity between the constructs. Intrinsic motivation has been defined comparably to student engagement and its subtypes, with one of the studies suggesting intrinsic motivation is a subtype of student engagement (Froiland & Worrell, 2016). This similarity between the current conceptualizations of intrinsic motivation and student engagement raises the question of the uniqueness of the two constructs. A clearer picture will surface by further delineating the conceptualizations of the concepts, which will aid in answering how student engagement influences the relationship between intrinsic motivation and academic achievement. Secondly, the current study mainly focused on combined student engagement without considering any subtypes as a potential intermediate step between intrinsic motivation and academic achievement. Past studies have also noted the need to analyze student engagement subtypes (Tao et al., 2022). Our study did not find the effect of vigor in the relation between intrinsic

motivation and academic achievement, however, other subtypes of student engagement could play a role in the proposed link. By assessing specific student engagement subtypes, better conceptualizations can be formed, and the influence of student engagement on the link between intrinsic motivation and academic achievement can be more deeply comprehended. A last possible area of improvement is that our findings showed limited generalizability to psychology students at the University of Groningen, with most students being female and Dutch. More research must be done to examine the accuracy of the results in highly diverse samples. Students with diverse characteristics may show different patterns between the investigated concepts, and the unique influence of student engagement in the relation between intrinsic motivation and academic achievement could be detected. Nevertheless, the sample size was highly sufficient, ensuring that the found relation can be asserted in our sample. When evaluating this paper, it becomes evident that various limitations should be solved to elucidate the research question further, prompting future research on the proposed relations.

More research is crucial to draw accurate conclusions about the influence of student engagement on the relation between intrinsic motivation and academic achievement. Firstly, the concepts of intrinsic motivation and student engagement should be clearly stated to define their differences more clearly. As there is a lack of studies investigating the relation between intrinsic motivation and student engagement, differentiating between the two constructs must be taken from the most similar studies. Reeve's (2012) conceptualization of student engagement utilizes cognitive, emotional, behavioral, and agentic engagement, which differs from the current one, combining vigor, absorption, and dedication. Using such conceptualizations of student engagement, Reeve and Tseng (2011) showed a low relation between student engagement and general motivation, meaning there was more considerable independence between the constructs. By considering the same student engagement conceptualization, student engagement, and intrinsic motivation could be differentiated more,

thereby aiding with disentangling the unique influence of student engagement in the relation between intrinsic motivation and academic achievement. The second consideration for future research is focusing on each student engagement subtype. To accomplish this, measures explicitly focusing on each subtype should be devised, For example, there exist measures specific to behavioral engagement, such as the observational measure of the Behavioral Engagement Related to Instruction (BERI) protocol, which could assist us in a more detailed understanding of the role of student engagement in the intrinsic motivation-academic achievement relation (Lane & Harris, 2015). Lastly, future research should consider using a more culturally diverse sample with an approximately equal distribution of biological sex to make the findings more generalizable. By utilizing these recommendations, future research may show a salient indirect effect of student engagement or any subtypes in the relation between intrinsic motivation and academic achievement. To summarize, future research holds excellent opportunities to solidify the findings of the research hypotheses and further extend them.

Conclusion

In summary, the study's main aim was to investigate if student engagement is one of the underlying mechanisms of the relationship between intrinsic motivation and academic achievement in university students. Student engagement, however, did not explain the mentioned link. Nevertheless, intrinsic motivation directly predicted academic achievement irrespective of student engagement, making it one of the factors contributing to it. Despite the great similarity between intrinsic motivation and student engagement, focus on the combined student engagement and use of a homogenous sample, our findings support past theory and research of intrinsic motivation and its central role in academic achievement. Solving the limitations above should be prioritized in future research to discover an intermediate role of student engagement in the relationship between intrinsic motivation and academic

achievement. The key takeaway is that while intrinsic motivation does not indirectly affect academic achievement through student engagement, boosting intrinsic motivation is one of the pivotal steps in enhancing University of Groningen students' performance.

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Appendix A

Assumption Checks

Figure A1

Scatterplot of Standardized Residuals on the y-axis With Standardized Predicted Values on
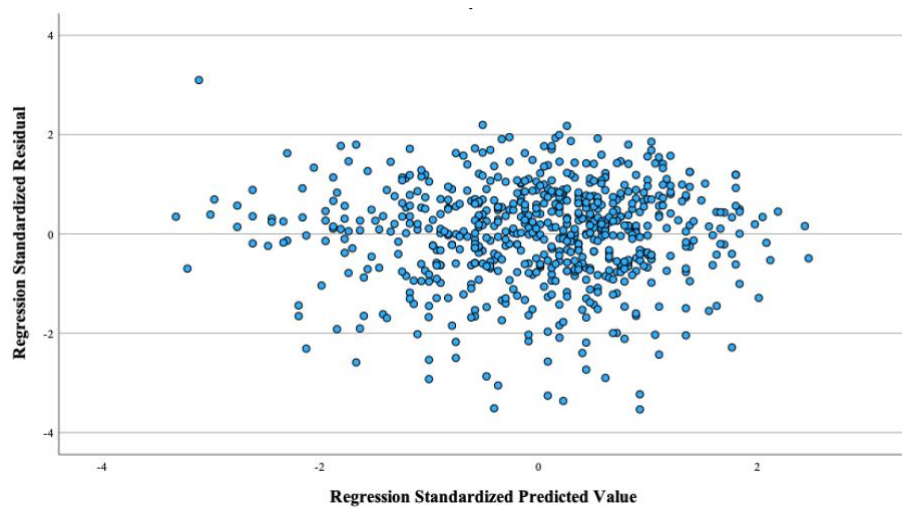
the x-axis Portraying Random Scatter

Figure A2

P-P Plots for Predictor, Outcome, and Mediator Variables, Showing Straight Lines Following
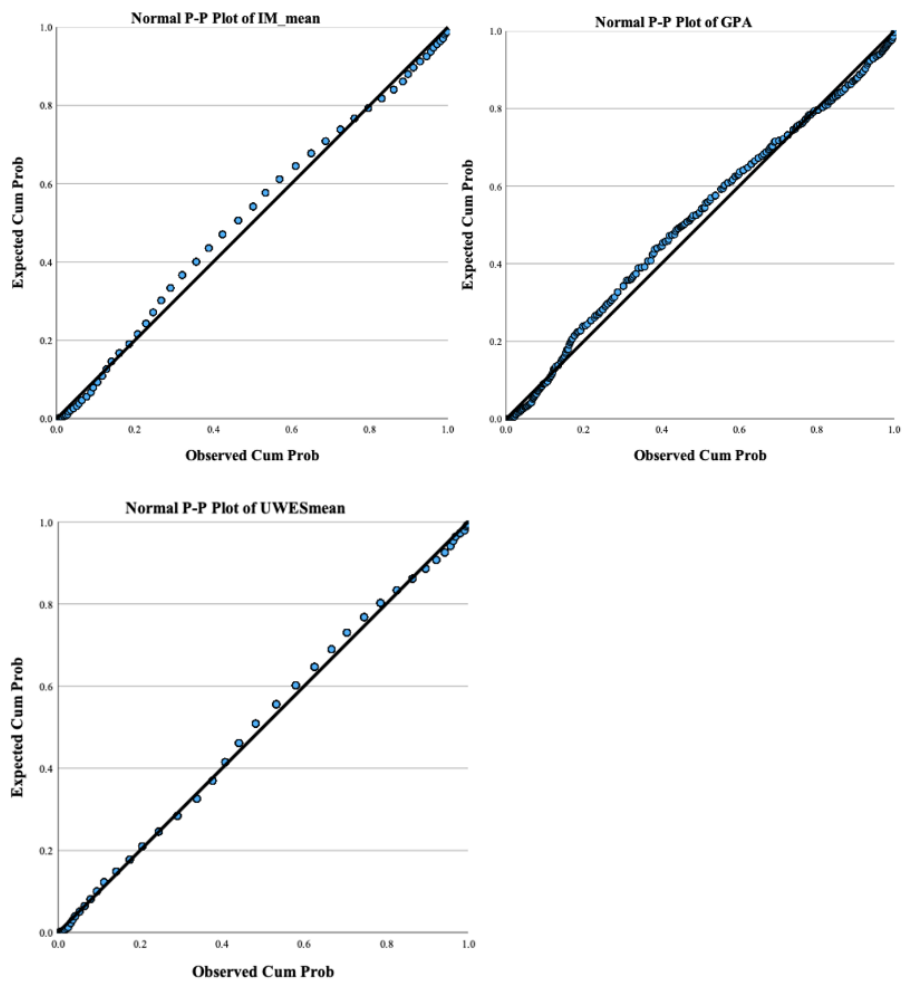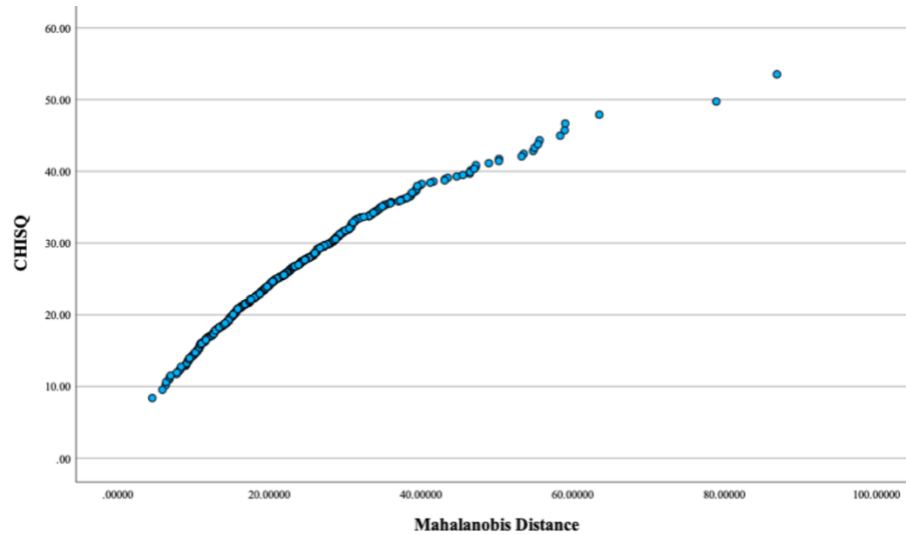
Normal Distribution

Figure A3

Chi-Square on the y-axis and Mahalanobis Distance on the x-axis, Showing a Straight Linear

Line

Table A1

Tests for Assumptions of Linearity, Outliers, Independence of Residuals, and a Non-

significant Interaction of Predictor and Mediator

Assumptions	Variables	
Linearity	Linearity (AA&IM)	$p<.001$
	Linearity (AA&Engagement)	$p=.006$
	Deviation from Linearity (AA&IM)	$p=.289$
	Deviation from Linearity (AA&Engagement)	$p=.504$
Outliers	Cook's distance	M=.002
Independence of residuals	Durbin-Watson	1.96
Interaction (IM&Engagement)		$p=.644$

Note: IM= intrinsic motivation, AA= academic achievement