Lecturer Teaching Style and Learning Style do not affect academic Achievement: A Report on Evidence of a Mediating Variable

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ABSTRACT

Purpose

The roles of lecturers' teaching styles and students' learning styles remain uncertain regarding their impact on academic performance. This study investigates the effects of these styles on academic achievement among religious students, aiming to develop new strategies for the teaching and learning processes.

Methodology

The participants in this research were religious students from South Sulawesi, Indonesia, who actively engaged in their studies from 2021 to 2024, comprising a total of 754 individuals (43.5% male, 56.5% female). The data is analyzed using SEM-PLS software.

Findings

The findings indicate that neither of these variables significantly influences academic achievement unless mediated by intelligence. Intelligence acts as a mediating variable, facilitating the influence of lecturers' teaching styles and students' learning styles on academic performance. The researchers argue that lecturers play a crucial role in delivering instructional content through appropriate methods, designing engaging learning activities, and providing memorable educational experiences for students.

Novelty

This study is the first to compile 7 variables that are presumed to influence academic achievement, using 2 mediating variables.

Significance

This study suggests that innovations in teaching practices and enhanced student interactions are crucial for fostering intelligence. Such developments enable students to absorb knowledge effectively, refine their abilities, and cultivate the learning experiences acquired in class, which are essential for navigating future professional environments.

Keywords: Mediating variable, Structural Equation Modeling, Influence, Intelligence, learning styles, teaching styles.

INTRODUCTION

Academic achievement is regarded as a key indicator of student success within higher education (Kell et al., 2013; Steinmayr et al., 2018). It influences future life outcomes (Hanushek, 2020) and reflects students' productivity and intellectual capabilities (Sothan, 2019). The relationship between students and lecturers is considered one of the critical determinants of learning achievement, established through fostering a positive rapport via character development and social understanding of ethics, manners, and norms (Berhanu &

Sabanci, 2020). Collaboration among schools, families, and diverse teaching styles forms a comprehensive system aimed at achieving learning objectives by accommodating the varying characteristics of students (Khumalo & Utete, 2023; Sadiku & Sylaj, 2019). Theoretically, academic achievement can be supported by external factors, such as learning facilities, lecturers' teaching methods, parental involvement, and the surrounding environment (Chan & Dai, 2023), while internal factors stem from the students themselves (Ozcan, 2021). Consequently, educators are required to think creatively in employing a variety of teaching styles tailored to the specific needs of their students (Tang et al., 2022), ensuring a more effective educational experience.

Academic quality is reflected in students' achievements, serving as a measurable indicator (Oyewobi et al., 2020). These achievements are significantly influenced by ongoing efforts to enhance educational standards and academic research (Ede & Igbokwe, 2018). Key variables closely associated with academic success include intelligence, motivation, and academic interest (Arthur & Everaert, 2012; Duff & Mladenovic, 2015; Sternberg, 2019). Additionally, diverse learning styles among students can impact their performance (Dryer et al., 2016). Each student has a preferred learning method, which helps alleviate the burden of coursework (Kumar et al., 2017). This study will empirically investigate seven variables, demonstrating that the interaction between lecturers' teaching styles and students' learning preferences does not directly influence academic achievement without the presence of an intervening variable. Ultimately, understanding these dynamics is essential for improving educational outcomes and fostering effective teaching and learning environments.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Numerous studies suggest that student understanding is significantly influenced by lecturers' teaching styles (Esmail Sabra et al., 2018). Other researchers have identified a moderate correlation between teaching styles and academic achievement (Chetty et al., 2019). It is recommended that lecturers align their practices with effective teaching indicators and demonstrate mastery of the subject matter, as this significantly enhances student comprehension (Husin et al., 2023; Keerthigha & Singh, 2023; Shaari et al., 2014). A lack of subject mastery and ineffective presentation skills adversely impacts teaching styles (Esmail Sabra et al., 2018), which consequently affects student interest and understanding (Chetty et al., 2019). Monotonous, one-dimensional lecture formats often lead to disengagement and reduced focus among students (Tang et al., 2022). While some studies have found no significant correlation between teaching style and student academic achievement (Shaari et al., 2014), it remains vital to explore these dynamics further. In this study, the variable of lecturers' teaching style will be measured using four indicators on a Likert scale of 1-6 (ranging from strongly agree to strongly disagree), hypothesising the following:

H1: Lecturer teaching style does not significantly affect academic achievement.

Learning style variables have been investigated by Vidyakala et al. (2019), who studied a sample of 103 students in India, and by Thu Ha (2021), who examined 307 students in Thai Nguyen City, Vietnam. Both studies found a significant correlation between student learning styles and academic achievement. However, some researchers did not identify a significant relationship between these variables(Awang et al., 2017; Kohan et al., 2021; Mozaffari et al., 2020). They argue that each student possesses a distinct learning style, which may not be the primary determinant of academic success. Nevertheless, learning styles and patterns significantly aid students in acquiring information and knowledge (Ahinful et al., 2019). A learning style refers to an individual's preferred approach to absorbing information in a way that is most comfortable and memorable (Mozaffari et al., 2020; Vidyakala et al., 2019), In this study, the learning style variable is measured using four indicators on a Likert scale of 1-6 (from strongly agree to strongly disagree). The hypothesis posits:

H2: Learning style does not affect academic achievement.

Intelligence as a cognitive element plays a quite influential role, and is often considered the main factor in determining a person's success (Bate et al., 2022; Iqbal et al., 2021). Intelligence positively and significantly correlates with student academic achievement (Lozano-Blasco et al., 2022; Quilez-Robres et al., 2021; Zhoc et al., 2018). 212 correspondents were asked to complete the Raven's Progressive Matrix, Bar-On Emotional Intelligenc e Inventory, and Emo Sensory Intelligence Scale and then matched with GPA as a measure of their

academic achievement . The results showed that students' IQ and EQ levels could significantly predict academic achievement and proved to be positive predictors of academic success (Pishghadam et al., 2022). Other researchers found no relationship between intelligence and academic achievement in both male and female students (Iqbal et al., 2021). We will connect the previous two variables with intelligence as an intervening factor with the following hypothesis design:

H3: Intelligence significantly directly affects academic achievement.

Other factors that support academic achievement are physiology, academic interest, motivation, and learning environment. We will also investigate these variables to compare with lecturer's teaching style and learning style. There is a significant correlation between fitness and academic achievement (Donnelly, 2017; Niet et al., 2014; Redondo-Flórez et al., 2022; Shook, 2016). Other researchers claim that there is no significant effect between physical fitness and academic achievement (Bilgin et al., 2020). Physiological includes the physical condition of the body in supporting learning activities such as adequate nutrition, a body that feels fresh and healthy, and is not easily tired (Donnelly, 2017; Niet et al., 2014), and optimal sensory function conditions (Shook, 2016).

Interest is a source of motivation that encourages people to do what they want (Longobardi et al., 2018; Mappadang et al., 2022), including students' perceptions of the lesson, students' physical and psychological conditions, the attractiveness of the subject matter to students' lives, teachers' teaching methods and styles, and motivation (Blankenburg et al., 2016). Some researchers found a correlation between intrinsic interest and academic achievement (Ahinful et al., 2019; Blankenburg et al., 2016; Duff & Mladenovic, 2015; Fallan & Opstad, 2014; Lee et al., 2014; Mappadang et al., 2022). But Meyer et al (2019) argue that it is academic so that interest does not correlate with academic achievement.

Several researchers proved the correlation between motivation and academic achievement (Foong & Liew, 2022; Goodman et al., 2011; Sivrikaya, 2019; Yarin et al., 2022). However, Bakar et al (2022) did not find the effect of learning motivation on academic achievement. Motivation serves as a driver for action and leads to the goal to be achieved (Yarin et al., 2022), which is determining what activities must be done to achieve targets and goals by setting aside activities that are not beneficial to the goal (Bin Abdulrahman et al., 2023; Sharma & Sharma, 2018; Sivrikaya, 2019). Supported by the learning environment is a place where students can interact with their environment (Al-Qahtani, 2015; Edgerton et al., 2011; Mørk et al., 2020), so that students can learn conducively to achieve academic achievement. Some of these variables can be hypothesized as follows:

H4: Physiological significantly directly affects academic achievement.

H5: Academic interest significantly directly affects academic achievement.

H6: Motivation significantly directly affects academic achievement.

H7: Learning environment significantly directly affects academic achievement.

METHODOLOGY

Participant

The research contributors were students in the field of religion who were still actively studying in 2020-2023 from 3 universities in South Sulawesi Indonesia, totaling 5674 populations. Hair et al (2021) state that the sample size used for PLS-SEM research can use the method recommended by Kock & Hadaya (2016), namely using the exponential gamma distribution (for the lower limit) and the inverse square root (for the upper limit). The larger the sample in PLS, the more it can increase the precision or consistency of the estimated PLS parameters (Hair et al., 2021).

$$5\% : n_{min} >= [\frac{2.486^2}{P_{min}}]$$

The sample size of this study is based on the strength of statistical tests in general of 80%, the significance of the path coefficient or the assumption of influence between variables lies in the interval 0.11-0.2, and the alpha level of significance of 5%. Based on the sample size obtained from the above formula, the research respondents must be at least 155. A total of 800 questionnaires were distributed and 754 corresponds met the requirements of the analysis test. Academic achievement as the dependent variable is measured by the results of Grade Point Average (GPA) (Abbassi et al., 2018; Ezenwoke et al., 2020; Pérez-López & Ibarrondo-Dávila, 2019). GPA ratio data were transformed and categorized: if GPA ≥ 3.76 = 3 (High), GPA 3.25-3.75 = 2 (Average) and if GPA < 3.25 = 1 (Low).

Table 1. Variable Description

Characteristics	Categories	Indicator	Number	Percentage
Variable	Phys	3		
	IQ	4		
	AI	6		
	LE	4		
	MOT	5		
	LTS	4		
	LS	3		
GPA	≥ 3.76 = 3 (High)		400	53.05%
	3.25-3.75 = 2 (Medium)		344	45.62%
	< 3.25 = 1 (Low)		10	1.33%
Gender	Male		328	43.50%
	Female		426	56.50%

Note: Academic achievement (AA) are measured based on Grade Point Average (GPA). Physiological (Phys), Intelligence (IQ), Academic interest (AI), Learning environment (LE), Motivation (MOT), Lecturer teaching style (LTS), Learning style (LS).

Data Analysis

Data analysis used PLS-SEM, a multivariate statistical approach that allows for the simultaneous estimation of multiple relationships between variables, commonly applied in prediction, exploration, and structural model development research (Hair et al., 2019) In mediation analysis, we examine whether changes in independent constructs result in changes in mediator variables that will affect the dependent construct in a model. The purpose of the measurement model is to evaluate the extent to which manifest variables effectively represent each exogenous and endogenous latent variable (Dawson, 2014; Demming et al., 2017; Hair et al., 2017; Henseler et al., 2014; Sarstedt et al., 2017). Research involving causal chains, such as "A influences B, which in turn influences C," or more complex nomological networks with intervening variables (mediation), is not suitable for using simple linear regression methods because the measurement model estimates are done partially and not simultaneously, with consequences for the quality of the results that are not accurate (Hair et al., 2021; Henseler et al., 2015; Sarstedt et al., 2020). PLS-SEM applies two evaluation models, the structural model (inner model) as a representative of the structural paths in the form of constructs (Henseler et al., 2015; Risher & Hair, 2017), and the measurement model (outer model), which describes the connection between each construct and its associated indicators (Dijkstra & Henseler, 2015; Hair et al., 2021).

RESULTS

Proof of Hypothesis

Table 1 reveals that the majority of respondents are female (56.5%), with males constituting 43.5%. The respondents' Grade Point Average (GPA) was generally dominated by a high GPA (53.05%), then medium (45.62%), and low (1.33%). This shows that academic achievement indicators can generally be measured well. **Table 2** outlines the statistical properties of the research variables, including the mean, median, standard deviation, minimum and maximum values, kurtosis, and skewness. It also shows that all data items are normally distributed except item (AI 2) with an excess kurtosis value above 2 (2.496). The distribution of data for the academic interest variable indicates a minimum score of 1, a maximum score of 6, an average mean value (M = 4.8), and an average standard deviation (SD = 0.88). These results indicate that students' academic interest is relatively large by looking at the proximity of the mean value and the maximum scale of 6 or it can be interpreted that interest and making their campus their first choice and priority is in the high category, which is 80%. Likewise, the variance of the data is relatively large by looking at the distance of the mean value and standard deviation.

The lecturer teaching style variable measured by 4 indicators in the form of lecturer personality, teaching methods, achievements, and involving students shows a minimum value of 1 and a maximum of 6, with a mean value (M = 4.63), and standard deviation (SD = 0.82). This suggests that, on the whole, lecturers demonstrate a relatively strong performance in terms of their personality, achievements, student engagement, and teaching methods, with 77% of lecturers falling into the "fairly good" category. The learning style variable, measured by three indicators: visual, auditory, and kinesthetic, shows a minimum value of 1 and a maximum of 6, with a mean value (M = 4.2), and standard deviation (SD = 0.62). These results indicate that students' learning styles are generally a mix of visual and audio learning styles by 70%.

Table 2 Descriptive Statistics

Name	Mean	Median	Scale min	Scale max	Std. dev	Excess kurtosis	Skewness	Cramér-von Mises p value
AI.1	4.429	4.333	1	6	1.014	-0.561	-0.141	0
AI.2	5.017	5	1	6	0.771	2.496	-0.860	0
AI.3	4.674	5	1	6	0.899	-0.302	-0.101	0
AI.4	4.859	5	1	6	0.894	-0.144	-0.368	0
AI.5	5.202	5	2	6	0.832	-0.273	-0.698	0
AI.6	4.402	4.5	2	6	0.853	-0.045	-0.071	0
LE.1	3.908	4	1	6	0.867	0.101	-0.01	0
LE.2	3.908	4	1	6	0.966	0.282	0.035	0
LE.3	4.358	4	1	6	1.036	0.477	-0.256	0
LE.4	4.21	4	1	6	1.016	0.038	-0.155	0
Phys.1	4.25	4.25	1	6	0.95	-0.287	-0.219	0
Phys.2	3.521	3.333	1	6	0.851	0.058	0.311	0
Phys.3	4.096	4	1	6	0.77	0.516	-0.006	0
LTS.1	4.455	4.5	1	6	0.795	0.353	-0.159	0
LTS.2	4.852	5	1	6	0.79	-0.095	-0.32	0
LTS.3	4.438	4.5	1	6	0.854	0.729	-0.277	0
LTS.4	4.76	5	1	6	0.845	0.113	-0.328	0
MOT.1	3.42	3.5	1	6	1.368	-0.635	0.003	0

MOT.2	4.904	5	1	6	0.78	0.691	-0.472	0
MOT.3	4.302	4.333	1	6	0.963	0.111	-0.472	0
MOT.4	4.684	4.75	2	6	0.74	0.187	-0.308	0
MOT.5	4.94	5	2	6	0.869	0.28	-0.728	0
IQ.1	4.054	4	1	6	0.8	0.139	-0.014	0
IQ.2	3.794	3.75	1	6	0.74	0.352	0.053	0
IQ.3	3.883	4	1	6	0.751	-0.062	0.111	0
IQ.4	4.025	4	1	6	0.69	0.315	0.223	0
LS.1	4.242	4.3	1	6	0.587	1.65	-0.303	0
LS.2	4.347	4.3	1	6	0.656	0.137	-0.023	0
LS.3	3.97	4	1	6	0.615	0.788	-0.152	0
AA	3.737	3.77	3.06	4	0.181	0.812	-0.891	0

The learning environment measured by 4 indicators shows a minimum value of 1 and a maximum of 6, the average mean value (M = 4.096), and the average standard deviation (SD = 0.97). This indicates that the atmosphere students feel in the learning environment is quite good, which is 68%, with a relatively large data variance by looking at the close mean value and standard deviation. 3 indicators measure physiological variables show a minimum value of 1 and a maximum of 6, the average mean value (M = 3.96) and the average standard deviation (SD = 0.86), in general students have a good physique and maintain diet and hygiene with a score of 66%.

The results of motivation variable show that this variable has an average mean value (M = 4.45) and an average standard deviation (SD = 0.94). It can be interpreted that student motivation internally (factors from within) and externally (factors from outside) is in the good category of 74%. The average mean value of intelligence variable (M = 3.94) and the average standard deviation (SD = 0.75) show that the level of intelligence of students is in the medium or high enough category by 66%.

Evaluation of the Reflective Measurement Model

Based on **Figure 1**, all variables are measured by valid indicators with outer loading between 0.804 - 0.890, indicating that the indicators are valid to reflect the measurement of academic interest, learning environment, physiological, lecturer teaching style, motivation, intelligence, and learning style. This finding concludes that the influence of all exogenous variables (learning environment, physiological, lecturer teaching style, learning style, academic interest) on endogenous variables (intelligence, motivation and academic achievement), as well as between endogenous variables is linear or the linearity effect of the model is fulfilled (robust).
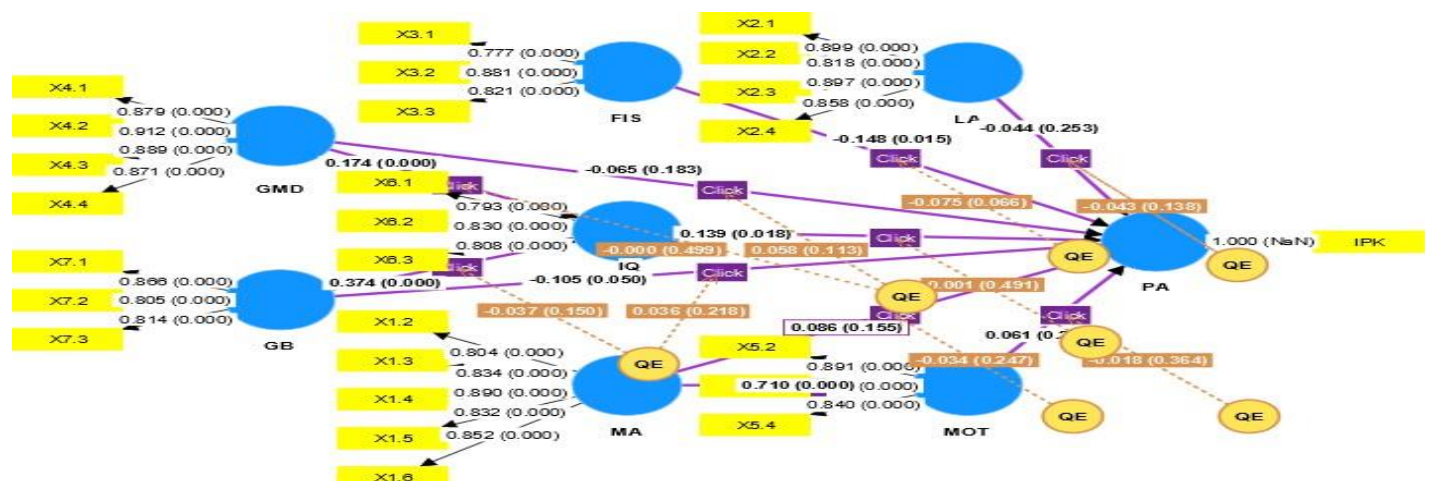

Figure 1 Output of Loading Factor

Table 3 Measurement Model Test Output

Variables	Cronbach's Alpha	Composite Reliability	AVE
Academic Interests	0.898	0.924	0.710
Learning environment	0.895	0.925	0.754
Physiological	0.771	0.866	0.684
Lecturer teaching style	0.910	0.937	0.788
Motivation	0.807	0.886	0.721
Intelligence	0.739	0.852	0.657
Learning style	0.776	0.868	0.687

The reliability of the variables is deemed satisfactory. As presented in **Table 3** both cronbach's alpha and composite reliability exceed 0.70, indicating that the measurement items are both consistent and dependable in assessing the variables. Additionally, the convergent validity, with an Average Variance Extracted (AVE) greater than 0.50, satisfies the criteria for good convergent validity. In general, the variance explained by the measurement items within the variables ranges from 65.7% to 78.8%.

Table 4 Output of Fornell-Larcker and Heterotrait-Monotrait Ratio (HTMT)

	Fornell-Larcker								Heterotrait-Monotrait Ratio (HTMT)							
	Phys	LS	LTS	IQ	LE	MA	MOT	AA	Phys	LS	LST	IQ	LE	AI	MOT	AA
Phys	0.827															
LS	0.453	0.829							0.580							
LTS	0.475	0.439	0.888						0.561	0.523						
IQ	0.375	0.463	0.352	0.811					0.501	0.590	0.427					
LE	0.355	0.345	0.496	0.213	0.869				0.430	0.416	0.555	0.248				
AI	0.467	0.475	0.554	0.34	0.427	0.843			0.559	0.561	0.614	0.420	0.479			
MOT	0.47	0.615	0.543	0.415	0.427	0.71	0.849		0.605	0.761	0.624	0.532	0.507	0.821		
AA	-0.151	-0.079	-0.085	0.04	-0.09	-0.001	-0.017	1	0.168	0.093	0.088	0.047	0.089	0.021	0.029	

The physiological variable has a root AVE (0.827) greater correlation than other latent variables in **Table 4**. These results indicate that the discriminant validity of the academic interest variable is met. In the sense that the measurement items of physiological variables focus on measuring physiological variables and are low in measuring other variables, or physiological variables divide their variance more to their measurement items than to other variable measurement items. Likewise, the learning style variable has an AVE root (0.829), lecturer teaching style (0.888), intelligence (0.811), learning environment (0.869), academic interest (0.843),

and motivation (0.849), the overall AVE root of these variables is greater than the correlation of other latent variables. It is concluded that overall these measurement variables have good discriminant validity according to the Fornell-Larcker method. The test results in **Table 4** show that the HTMT value of each variable that correlates with other variables is below 0.90, so discriminant validity is said to be met.

Evaluation of Goodness and Fit of the Model

The qualitative interpretation value of R-square is 0.19 (low influence), 0.33 (moderate influence), 0.66 (high influence) (Hair et al., 2021). The results of data processing explain the magnitude of the influence of lecturer teaching styles and student learning styles on student intelligence by 23.8% (classified as an influence towards the medium). The magnitude of the influence of academic interest on student motivation is 50.3% (classified as an influence towards high). While the magnitude of the joint influence between lecturers' teaching styles, student learning styles, academic interest, and motivation on academic achievement amounted to 3.1% (classified as a very low influence). Q-square describes a measure of prediction accuracy, namely how well each change in exogenous/endogenous variables is able to predict endogenous variables. This measure is a form of validation in PLS-SEM to state the suitability of model predictions (predictive relevance). Based on **Table 5**, the q-square value of all variables other than intelligence is in the high category ($Q^2 \geq 0.35$).

Table 5 Output of R-Square, Effect Size of Q-Square, and Standardized Root Mean Square Residuals

Variable and Categories	R-square	Adjusted R-square	SSO	SSE	Q² (=1-SSE/SSO)	SRMR	d_ULS	d_G	Chi-square	NFI
IQ	0.242	0.238	1131	776.972	0.313					
MOT	0.504	0.503	1131	643.709	0.431					
PA	0.049	0.031	377	0	1					
FIS			1131	716.281	0.367					
GB			1131	714.71	0.368					
GMD			1508	557.793	0.63					
LA			1508	642.373	0.574					
MA			1885	831.064	0.559					
Saturated model						0.061	1.300	0.519	1179.24	0.800
Estimated model						0.080	2.247	0.585	1272.19	0.784

The SRMR value below 0.08 indicates a model fit. While the Goodness of Fit Index (GoF Index) is an overall evaluation of the model which is an evaluation of the measurement model and the structural model. This GoF Index can only be seen from the reflective measurement model, namely the root of the geometric multiplication of the average communality with the average R-square. The interpretation of the GoF Index value is 0.1 (low GoF), 0.25 (medium GoF) and 0.36 (high GoF) (Henseler et al., 2014; Wetzels et al., 2009).

GoF = $\sqrt{(}$ Average of AVE x Average of $R - Square)$

= $\sqrt{(}0,714$ x $0,257) = 0,429$

The calculation results show that the GoF model is 0.429, including the GoF Index in the high category. Empirical data can explain the measurement and structural models with a high level of fit.

Table 6 PLS Predict Test

	Q²predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE
IQ.1	0.170	0.731	0.582	0.742	0.587
IQ.2	0.146	0.686	0.547	0.693	0.542
IQ.3	0.130	0.703	0.566	0.703	0.564
MOT.2	0.473	0.567	0.454	0.538	0.426
MOT.3	0.268	0.826	0.633	0.768	0.583
MOT.4	0.322	0.611	0.481	0.563	0.435
GPK	0.005	0.181	0.144	0.186	0.148

Based on **Table 6**, the results of data processing from 14 observations of the RMSE and MAE values, there are 8 PLS model measurement items with RMSE and MAE values lower than the LM (linear regression) model, indicating that the proposed PLS model has medium predictive power and is considered appropriate.

Structural Model Evaluation (Hypothesis Test Interpretation)

Table 7 shows that the Inner VIF values of exogenous latent variables (physiological, lecturer teaching style, learning style, learning environment, academic interest, and motivation) and endogenous variables (including intelligence and academic achievement) are not multicollinear (inner VIF < 5). This finding strengthens the parameter estimation results in PLS-SEM is robust (unbiased).

Table 7 Multicollinearity Test Output (Collinearity Statistics VIF)

	Phys	LS	LTS	IQ	LE	AI	MOT	AA
Physiological								1.534
LS				1.238				1.831
LTS				1.238				1.818
IQ								1.37
LE								1.425
AI							1	2.26
MOT								2.649
AA								

Table 8 Structural Model for Direct Effect and Mediation Test Output (Indirect Effect)

Hypothesis	Path Coefficient	P-values	95% Confidence Interval Path Coefficient		f-Square	Upsilon V
			Lower limit	Upper limit		
H1. LTS --> AA	-0.062	0.19	-0.174	0.058	0.002	
H1$_a$. LTS --> IQ	0.184	0	0.102	0.269	0.036	
H2. LS --> AA	-0.091	0.062	-0.187	0.007	0.005	
H2a. LS --> IQ	0.382	0	0.292	0.47	0.155	

H3. IQ --> AA	0.125	0.02	0.028	0.228	0.012		
H4. Phys --> AA	0.181	0.003	0.086	0.292	0.023		
H5. AI --> AA	0.103	0.11	-0.033	0.244	0.005		
H5. AI --> MOT	0.71	0	0.659	0.76	1.017		
H6. MOT --> AA	0.057	0.249	-0.081	0.194	0.001		
H7. LE --> AA	-0.058	0.182	-0.163	0.038	0.003		
MA --> MOT --> PA	0.04	0.251	-0.057	0.14		0.002	
GB --> IQ --> PA	0.048	0.029	0.01	0.094		0.02	
GMD --> IQ --> PA	0.023	0.046	0.04	0.49		0.01	

Intelligence acts as a mediator of the indirect effect of student learning styles on academic achievement, as shown in **Table 8**, with a path coefficient of 0.048 and a p-value of 0.029 ($p < 0.05$). Likewise, it is proven that intelligence acts as a mediator in mediating the indirect effect of lecturer teaching style on academic achievement with a path coefficient (0.023) and p-value (0.046 < 0.05). However, motivation is not empirically proven to mediate the effect of academic interest on academic achievement even though the path coefficient is positive (0.040), because the p-value is greater than 5% (0.251 > 0.05).

DISCUSSION

In the first hypothesis (H1) there is no significant direct effect of lecturer teaching style on academic achievement. This finding contradicts the findings of most researchers (Chetty et al., 2019; Esmail Sabra et al., 2018; Husin et al., 2023; Keerthigha & Singh, 2023). If you look at the measurement items on the lecturer's teaching style variable in **Figure 1**, the highest outer loading that reflects this variable is LTS 2 and LTS 3 in the form of competencies possessed by lecturers and the way lecturers teach in class. Nevertheless, the results of data processing found a simultaneous effect of lecturers' teaching styles on academic achievement through the intervening variable of student intelligence. This is supported by the significant effect of lecturer teaching style on student intelligence (H1a), and there is a significant effect of intelligence on academic achievement (H3). The better the lecturer's teaching style, the more it supports student intelligence, and the higher the student's intelligence, the greater the potential to improve academic performance. This shows that although the lecturer's teaching style does not directly affect academic achievement, student intelligence mediates the effect of the lecturer's teaching style on academic achievement. In line with the findings of Shaari et al (2014) who also did not find a direct effect of lecturer teaching style on academic achievement, but found an indirect effect of lecturer teaching style on academic achievement through moderating variables.

This finding shows that intelligence can support the influence of the lecturer's teaching style on improving academic achievement. Students who have high intelligence can digest well any output given by lecturers with any teaching methods and styles. This study recommends for lecturers to improve the quality of learning through effective and quality teaching styles by combining various methods. Several kinds of teaching styles can be applied by lecturers such as personal modeling, delegation, discussion, pedagogy, and lecture methods. All of these methods can be combined according to the characteristics of the students and the course being taught. The teaching style of lecturers also includes how lecturers can provide attention and warmth to students so that a psychological relationship is built between them (Keerthigha & Singh, 2023).

Similarly, in the second hypothesis (H2) there is no significant direct effect of student learning styles on academic achievement. This finding supports the research of (Awang et al., 2017; Kohan et al., 2021; Mozaffari et al., 2020). Although there is no effect, this finding can still contribute to providing information about the characteristics of student learning styles. The learning styles preferred by most students are visual and kinesthetic. Nevertheless, there is a simultaneous influence of learning styles on academic achievement through the mediating variable of intelligence. In other words, intelligence mediates the effect of learning style on academic achievement. This is reinforced by the significant direct effect of learning style on intelligence

(H2$_a$). The better and better the quality of students' learning styles, the better their intelligence, due to the habit patterns that train their brains and reasoning to continue to work and think positively. Simultaneously, students who have high intelligence will be able to adjust to any learning style that has a positive impact on improving their academic performance. Based on the significance of the path coefficient, we have constructed an illustration depicting the role of mediating variables in the effect of lecturer teaching style and student learning style on academic achievement, as shown in **Figure 2**.

Figure 2. Full Mediation or Partial Mediation Model Diagram
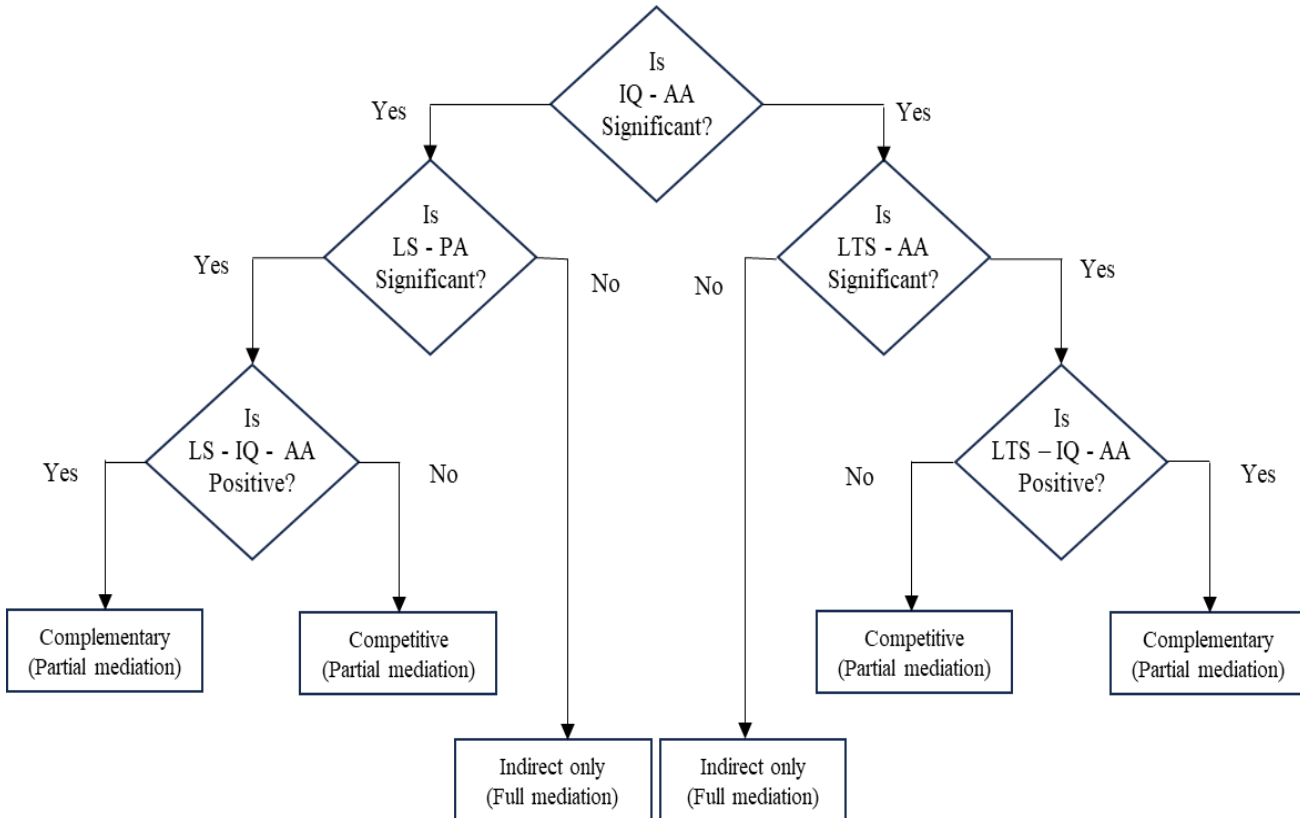
The statistical interpretation of the mediation effect is represented by Upsilon (V) values: 0.175 (high mediation effect), 0.075 (medium mediation effect), and 0.01 (low mediation effect) (Lachowicz et al., 2018; Ogbeibu et al., 2021). According to the calculations, the role of intelligence as a mediator in the indirect effect of lecturer teaching style and student learning style on academic achievement at the structural level is relatively low. However, within a 95% confidence interval, by conducting programs to improve intelligence, this mediating role will increase by 9.4% in mediating student learning styles and increase by 49% in mediating lecturer teaching styles to improve academic achievement.

Table 8 shows that intelligence has the highest direct effect on academic performance compared to learning environment, physiology, lecturer teaching style, student learning style, academic interest, and motivation. This finding indicates that any modification in intelligence is likely to result in a more pronounced improvement in academic achievement. Consequently, it can be inferred that, for educational institutions aiming to enhance academic performance through the influencing variables, prioritising the development of intelligence is essential due to its dominant effect on academic outcomes. Based on the recommendations of this study, one potential approach to enhancing student intelligence quality involves improving both the teaching styles of lecturers and the learning styles of students, as these two variables significantly influence intelligence.

CONCLUSION

This study contrasts with some previous research that suggests a significant influence of lecturer teaching style and student learning style on academic achievement. However, this research may be unique in its approach, as it positions intelligence as a mediating factor between these two variables and academic performance. In this

context, intelligence is found to serve as an intermediary variable, effectively mediating the simultaneous impact of both student learning style and lecturer teaching style on academic achievement. This novel perspective contributes to the understanding of how cognitive abilities can influence the relationship between teaching and learning processes and their outcomes in academic settings. Therefore, this study recommends students to immediately recognize the characteristics and explore the potential of their respective learning styles in order to get the appropriate formula to support the improvement of their intelligence so as to improve academic achievement. This finding also recommends lecturers to be able to recognize and accommodate the needs of students related to their learning styles to increase intelligence and academic achievement.

LIMITATIONS

While the findings have important implications, this research has several limitations. We only took data from 5 well-known universities in Eastern Indonesia, South Sulawesi. besides this research only focuses on observing religious students. Actually, broader research has been studied by several researchers (Baharudin et al., 2017; Jepsen et al., 2015; Mei Ph'Ng, 2018; Ph'ng et al., 2016). So that the results we get are different from similar studies. The number of variables we took may also make the focus of the data on the lecturer's teaching style and learning style biased so that the inconsistency of the expected results is obtained. We recommend a review that looks at universities in an unrestricted way and focuses on these variables.

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