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Analyzing multilevel model of educational data: Teachers' ability effect on students' mathematical learning motivation

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Abstract

Motivation to learn mathematics decreased due to the inability of teachers to implement innovative learning models and techniques. Therefore, this study aimed to investigate the effects of teachers' ability on students' motivation to learn mathematics by using quantitative methods and survey approaches. There were 32 mathematics teachers and 542 students in the 24 schools within the Depok region, selected as respondents through a stratified random sampling method. The research instruments of two questionnaires of teachers' competence and students' learning motivation were distributed to the respondents. Data analysis was conducted to test the random effect of teachers' ability on students' motivation to learn mathematics by using the effect of teachers' random intercepts and competence as models 1 and 2, respectively. These two models were analyzed using the n-level Structural Equation Model (nSEM), and the result showed that model 2 was the best one to investigate the random effect of teachers' ability and students' learning motivation. The data analysis showed that the variance among teachers' ability (0,0027) was less than learning motivation among students (0.0597). These findings indicated that the motivation levels of students taught by the same teacher varied significantly, whereas the effects of the teachers were relatively homogeneous. In other words, teachers' ability was somewhat the same in increasing students' learning motivation. Based on these findings, this research work suggests teachers keep improving their teaching techniques. Hence, students will be well motivated to learn so that the learning objectives will be well achieved.

Keywords: Mathematics Teachers, Students' Motivation, Teachers' Competence, Teachers' Random Effect

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Increasing students' motivation to learn mathematics in the 21st-century era is a big challenge for teachers. Teachers' inability to apply innovation in learning is one of the causes of low motivation to learn mathematics (Karali, 2022). Learning motivation is essential in developing the will and enthusiasm to learn, making students more focused and determined to absorb information and knowledge (Ferreira et al., 2011; Munawaroh et al., 2022; Yousaf et al., 2021), as well as increasing their achievement (Lo et al., 2022; Steinmayr et al., 2019). Students should be motivated to engage in learning activities to develop a habit and a desire to reach objectives (Zakaria et al., 2020). These learning activities cannot be separated from the roles of teachers in determining the quality of education (Kudryashova et al., 2015).

A teacher is a profession that requires specific skills (Boström & Bostedt, 2020), differentiating teaching from any other job. This set of skills is known as a teacher's competence (Omar et al., 2017; Siddiqui & Ahamed, 2020). Indonesian law number 16 of 2007 on the Ministry of Education and Culture about academic qualification standards and teacher competence states that competence can be pedagogic, social, professional, and personality (Hakim, 2015; Ningtiyas & Jailani, 2018; Wardoyo, 2015). Therefore, in every education process, the teacher's deep knowledge, pedagogy, attitude, personality, and behavior play important roles in student development (Amerstorfer & Münster-Kistner, 2021; Chen et al., 2022; Keiler, 2018). Noer (2019) showed the learning motivation related to teachers' competence was 0.83. Furthermore, Smit et al. (2021) supported this result by arguing that competence can increase learning motivation.

Mathematics is an exact science that needs reasoning to understand abstract mathematical objects (Cresswell & Speelman, 2020). This subject cannot be separated from human life since its basics are used every day. Furthermore, it is the result of human logic that consists of interconnected concepts (Benis-Sinaceur, 2014). The subject was introduced to students step by step hierarchically, according to their level of education.

Motivation is the process of changing behavior and using the energy directed by individual goals to stay focused (Aurangzeb et al., 2021). Therefore, learning motivation is very important for students to concentrate on the goals to be achieved. Carstens et al. (2021) reported that teachers' top priority is motivating students to learn new material to enhance their retention ability. A motivated student dedicates more time with a positive disposition toward mathematics to improve learning (Saadati & Celis, 2023). Conversely, those with low learning motivation easily give up when faced with more complicated problems (Fuqoha et al., 2018).

Xiao and Sun (2021) stated that motivation was closely related to achievement, persistence, and learning behavior. High-motivation students tend to accept challenges (Xiao & Sun, 2021). In addition, students with a good level of motivation have implications for their independent learning behavior, which can directly or indirectly affect academic success, specifically in mathematics (Herges et al., 2017). Wild and Neef (2023) showed a correlation between motivation and different learning strategies to improve academic performance. Furthermore, Hossein-Mohand and Hossein-Mohand (2023) also reported that motivation had a significant relationship with indicators of learning dimensions, particularly perceptions of teaching practices and resources for learning.

Two primary sources of motivation for learning mathematics are intrinsic and extrinsic: self-satisfaction and rewards, respectively (Arthur et al., 2022). Intrinsic motivation encourages students to enjoy learning mathematics, considering the subject as a challenge (Fiorella et al., 2021). This motivation is also supported by extrinsic motivation; hence, extrinsic motivation cannot be ignored (Klanderman et al., 2019). In learning mathematics in the classroom, the teacher's role in motivating students to learn mathematics optimally by using fun learning media and giving appreciation regardless of the results is part of extrinsic motivation.

Keller (2016), in 1984, developed ARCS: Attention, Relevance, Confidence, and Satisfaction to improve learning outcomes (Durrani & Kamal, 2021). The first aspect, namely *attention*, refers to interest, passion, and curiosity, which can be triggered by rewards and punishments, praise and verbal feedback, social interaction, and expectations (Greer, 2016). The second aspect, *relevance*, is the tendency of students to relate the material to the real world and previous theories, depending on their sociocultural and teaching methods of teachers (Belet, 2018). This aspect can be improved by providing meaningful learning and identifying what is already known (Bryce & Blown, 2023). The third aspect, *confidence*, focuses on the hope of success that can control the student learning process.

Teachers must increase students' confidence and reduce their fear of failure (Akbari & Sahibzada, 2020). The last aspect is *satisfaction*, a combination of intrinsic and extrinsic motivation results that enables students to maintain desired and unwanted learning behavior. This aspect can be increased by improving the quality of service (Snopce & Alija, 2018) and applying effective learning methods (Aznam et al., 2022).

The role of mathematics teachers is the primary key to success in the subject (Obradovic & Mishra, 2020). A broad and deep understanding is required to teach the students (Love & Hughes, 2022). Teachers must apply various learning methods in class because each student is different in how they learn (Cavite & Gonzaga, 2023). However, many teachers still use conventional teaching methods. Hence, the skills of students cannot be optimized. Conventional approaches typically involve passive learning (Diepreye & Odukoya, 2019), which can restrict students' capacity to apply knowledge in real-world situations and cultivate analytical skills (Noreen & Rana, 2019). Creativity in applying learning methods can prevent boredom more easily (Cheng, 2023), and this is also caused by the lack of ability to use ICT and facilities (Wang, 2023).

Tambunan (2018) stated that the dominant factors in the role of teachers as motivators were conveying learning objectives, convenience, and variations in approaches. According to Doño and Mangila (2021), high involvement positively contributes to the willingness to learn essential concepts and skills. Yang & Kaiser (2023) explained that teacher quality was the main factor affecting student learning outcomes. Furthermore, mathematics teachers must also be able to solve problems, teach, and be professional (Podkhodova et al., 2020). Professional competence is one of the most essential mathematics teacher competencies to develop (Jupri et al., 2022). Teachers employed diverse methodologies, such as their passion, to exemplify and maintain students' engagement in activities and assignments (Radil et al., 2023). Furthermore, teachers must provide high-quality, timely student feedback and necessary help and support (Al-Said, 2023). On the other hand, Maliqi and Borincaj-Cruss (2015) revealed that the cognitive and affective aspects of teachers have an impact on increasing students' learning motivation.

Teachers' pedagogical, personal, social, and professional competencies are based on the Regulation of the Minister of National Education of Indonesia No. 16 of 2007 (Nur'aini et al., 2019). Competencies support teachers in increasing student learning motivation (Kiemer et al., 2018). Pedagogic competence refers to teachers' abilities related to education, the educational process, students' character, and the educational process's assessment (Syahrial et al., 2020). Personality development is very important in teacher competence, namely patience, punctuality, neatness, breadth of mind, and open-mindedness (Flores, 2019), determining student learning activities and self-development (Ovchinnikova et al., 2020). In addition, social competence is essential for a teacher to interact with the students. Teachers can communicate and interact effectively with any group, including students with various characteristics (Asriati et al., 2022). Professional competence complements the quality of the teacher planning process (Hammer & Ufer, 2023). Furthermore, Lauermann and König (2016) reported that professional knowledge, skills, beliefs, and motivation hold a crucial role in predicting the professional well-being and success of teachers.

Clark et al. (2014) said that each teacher has a unique heritage and characteristics. Therefore, teachers and schools produce various student abilities (Palardy, 2010). The effect can be described as the class's variance component or the teachers' random effect (Prasertcharoensuk et al., 2018). This research investigated the random effect of teachers and teacher competency factors on student motivation to learn mathematics in Depok using the n-Level Structural Equation Model (nSEM). This study was essential to explore the effect of teachers' ability on the diversity of student mathematics learning motivation in the classroom. The relationship between students and teachers was multilevel in which students conceptualized as nested within the teacher. NSEM can be used to analyze data with a multilevel structure, and latent factors are measured by indicators. This study addresses the existing research void about the relationship between students' learning motivation and teachers' ability, aiming to enhance students' willingness to learn mathematics. Adding teacher competency factors to multilevel models can provide additional insight into student and teacher relationships. Therefore, this research aimed to identify a model that explains the random effect of teachers on student motivation to learn mathematics. The findings of this research can be used as recommendations for teachers, schools, and local governments to improve mathematics education from the perspectives of teachers' role in improving students' motivation to learn mathematics. It can be done through learning approaches and programs for teachers guided by insight into the structural relationship between students and teachers to create a meaningful learning environment for every student.

METHODS

A quantitative method with a survey approach was used to analyze the effect of teacher competence and random effect on student motivation to learn mathematics. The survey was conducted by distributing questionnaires to respondents.

Participants

The respondents were math teachers and students of junior high in Depok. The samples were selected by using a stratified random sampling method in 3 selected districts in Depok, namely Sawangan, Bojong Sari, and Limo with 11, 7, and 6 schools, respectively. The sample selection practice in this research used stratified random sampling so that the selected sample could be considered representatives of the population. From the 24 selected schools, there were 32 math teachers and 542 students participated as respondents. There were varying effects on learning motivation due to the background and personality of the teachers. For instance, a certified status indicates that the educator has already met professional requirements for the profession. Table 1 shows the characteristics of the teachers, where 14 (43.75%) of them have already held certification. The most significant number with the status of non-permanent foundation (3) accounts for 13 (40.62%) and only 1 (3.13%) has taught for more than 30 years.

Table 1. Characteristics of teachers

Characteristic	Category	Count	Percentage
Certification Status	(1) Yes	14	43.75%
	(0) No	18	56.25%
Employment Status	(1) Civil Service Teacher	8	25.00%
	(2) Permanent teachers of the foundation	11	34.38%
	(3) Non-permanent teacher foundation	13	40.62%
Teaching Duration (years)	< 11	16	50.00%
	11 - 20	10	31.25%
	21 - 30	5	15.63%
	> 30	1	3.13%

Variables

The variables were teachers' ability factor (single endogenous variable), teacher competence (teacher-level exogenous variable), and student motivation (endogenous variable). The research instruments comprised two questionnaires assessing teachers' competence and students' learning motivation. Participants were instructed to rate their responses using a 4-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). Thirty respondents tested the validity and reliability of the questionnaire but not a study sample. The item was valid when the Pearson correlation with the constructed variable was significant $(r > r_{\alpha,n-2})$ (Ahrens et al., 2020):

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2(y_i - \bar{y})^2}$$

with x item score and y total score in a variable. Teacher competence was measured by four aspects (Nur'aini et al., 2019). There were 44 (73.33%) valid items, namely pedagogic, personality, social, and professional competencies, with numbers 22, 7, 3, and 12 as valid items. Motivation was measured by four aspects (Keller, 2016) with 16 (100%) valid items, namely attention, relevance, confidence, and satisfaction, with numbers 6, 4, 4, and 2 valid items, respectively. The reliability was tested after testing the validity of the items from the construct variables. An item was deemed to possess a satisfactory level of reliability when Cronbach's alpha coefficient (*α*) exceeded 0.6 (Raharjanti et al., 2022). The Cronbach's alpha coefficient values were 0.954 and 0.899 for teacher competence and student motivation to learn mathematics. Hence, the two variables are reliable.

Data Analysis

Data analysis was conducted to determine teacher random effect on students' motivation to learn math by using latent random intercept models with and without teacher competency factors, as models 1 and 2, respectively. The two models were analyzed by using n-level SEM (nSEM) in R 3.0.2 (xxm package) proposed (Mehta, 2013) to accommodate problems arising from complex data (data with multilevel structure and include latent variable). They were also compared using lower Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and deviance.

Model 1: LatentRI

Level 1 : $y_{pi}^{1} = \nu_p^1 + \lambda_{p,1}^{1,1} \cdot \eta_{1i}^{1} + \varepsilon_{pi}^{1},$

Level 2 → Level 1 : $\eta_{1i}^{1} = \beta_{1,1}^{1,2} \cdot \eta_{1j}^{2} + \xi_{1i}^{1} = \eta_{1j}^{2} + \xi_{4i}^{1}$

where $\boldsymbol{y_{pi}^{1}}$ is student-level observed variable *p*-th student *i*-th (indicator variables *p*-th of student's motivation), $\boldsymbol{\eta_{1i}^{1}}$ is the student-latent variable (student's motivation variable), $\boldsymbol{\eta_{1j}^{2}}$ is the teacher-level latent variable (teacher's random effect). $\boldsymbol{\nu_p^1}$ is the intercept or the baseline of observed variable *p*-th, $\boldsymbol{\lambda_{p1}^{1,1}}$ is factor loading links *p*-th student-level observed variable $(\boldsymbol{y_p^1})$ and the student-level latent variable $(\boldsymbol{\eta_1^1})$, and $\boldsymbol{\beta_{1,1}^{1,2}}$ is a regression of the student-level latent and the teacher-level latent variables. The result is fixed at 1.0 because the model proposed a teacher-level random intercept for student motivation factor (Theobald, 2018). The model estimated the variance of teacher-level latent variable as a single parameter presented in Figure 1. The proportion of variance in student-level outcomes explained by the teacher-level random intercept is known as the intraclass correlation (ICC), and the dependent variable is:

$$\boldsymbol{ICC} = \frac{\boldsymbol{\psi_{11}^{22}}}{\boldsymbol{\psi_{11}^{22}} + \boldsymbol{\psi_{11}^{11}}}$$

where $\boldsymbol{\psi_{11}^{11}}$ is the covariance of the latent variable at the student-level and $\boldsymbol{\psi_{11}^{22}}$ is the covariance of the latent variable at teacher-level.

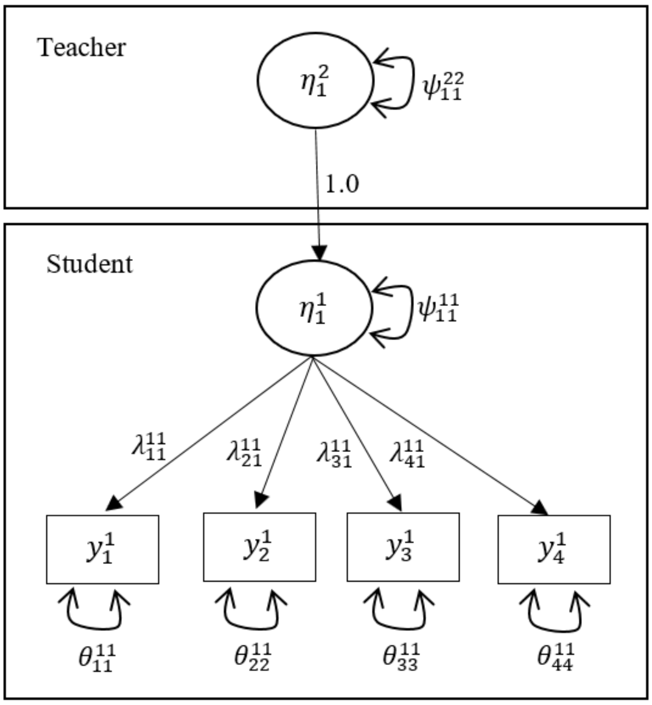

Figure 1. Model Path Diagram 1

Model 2: LatentRI with teacher's competence effect

Level 1 : $y_{pi}^1 = \nu_p^1 + \lambda_{p,1}^{1,1} \cdot \eta_{1i}^1 + \varepsilon_{pi}^1,$

Level 2 → Level 1 : $\eta_{1i}^1 = \beta_{1,1}^{1,2} \cdot \eta_{1j}^2 + \xi_{1i}^1 = \eta_{1j}^2 + \xi_{4i}^1,$

Level 2 : $x_{qj}^2 = \nu_q^2 + \lambda_{q,1}^{2,2} \cdot \eta_{2i}^2 + \varepsilon_{qi}^2, x_{qj}^2 = \nu_q^2 + \lambda_{q,1}^{2,2} \cdot \eta_{2i}^2 + \varepsilon_{qi}^2$

where $\boldsymbol{x_{qj}^2}$ is the teacher-level observed variable *q*-th teacher *j*-th (indicator variables *q*-th of teacher's competence), $\boldsymbol{\eta_{2j}^2}$ is the teacher-level latent variable (teacher's competence effect). $\boldsymbol{\beta_{1,2}^{2,2}}$ is the regression of a single teacher-level latent variable and the teacher-level teacher's competence latent variable. The model proposed a teacher-level random intercept and slope for the student's motivation factor, as presented in Figure 2. In this case, the structural model in Figure 2 explains that teacher-level variability in student motivation factor is predicted by competence.

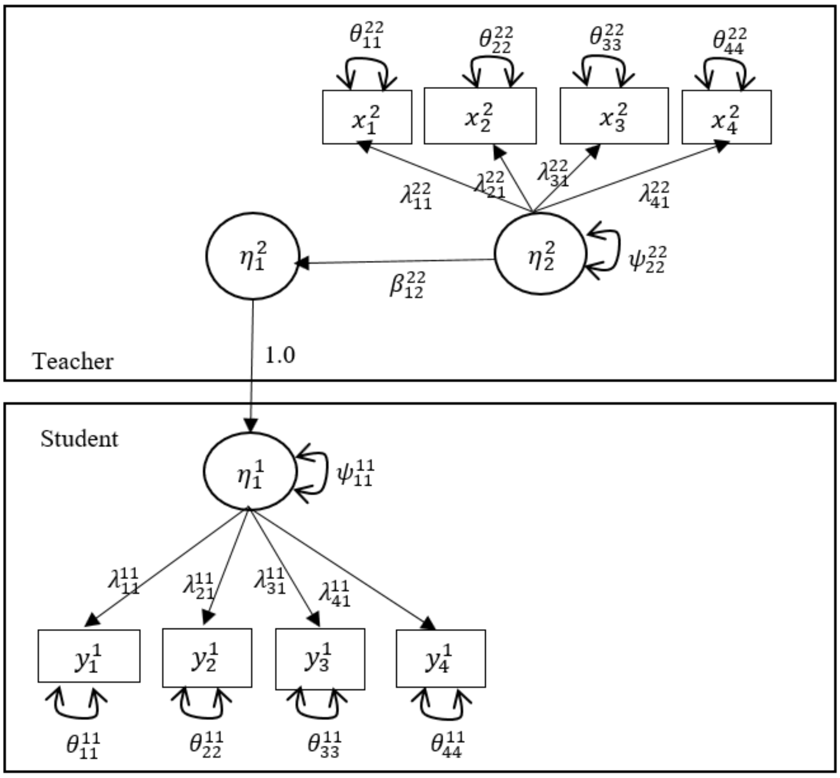

Figure 2. Model Path Diagram 2

RESULTS AND DISCUSSION

The Results of Model 1

Table 2 shows the outcomes of nSEM analysis of model 1, which consisted only of teachers' random intercepts. Fixed parameter estimation in Model 1 were all significant, as shown by a 95% confidence interval that did not contain value 0. The goodness of fit for Model 1 had a deviance value of 8021.715, while the AIC and BIC were 8047.715 and 8122.253. The range components for each level of student motivation data are also shown in Table 2. The level of teachers was lower since there was no diversity and a tendency towards homogeneity. Meanwhile, diversity among students in each class tends to be heterogeneous and the ICC score of 0.1954, or 19.54%, indicates the 2-level model was used effectively. These values are good enough for educational data (Mehta, 2013), such as student motivation.

Table 2. Result of model 1

Parameter	Estimate	CI
Fixed		
Attention intercept (ν_1^1)	18.799*	[18.538, 19.052]
Relevance intercept (ν_2^1)	14.996*	[14.700, 15.284]
Self-confidence intercept (ν_3^1)	9.003*	[8.785, 9.216]
Satisfaction intercept (ν_4^1)	7.014*	[6.915, 7.120]
Relevance $(\lambda_{2,1}^{1,1})$	1.021*	[1.033, 1.429]
Confidence $(\lambda_{3,1}^{1,1})$	0.860*	[0.728, 1.018]
Satisfaction $(\lambda_{4,1}^{1,1})$	2.257*	[0.182, 0.338]

Parameter	Estimate	CI
Random		
Student		
Attention	2.195	
Relevance	1.536	
Self Confidence	1.303	
Satisfaction	0.893	
Within (ψ_{11}^{11})	1.227*	[0.924, 1.586]
Teacher (ψ_{11}^{22})	0.298*	[0.147, 0.602]
Model Fit		
Deviance	8021.715	
AIC	8047.715	
BIC	8122.253	

The Result of Model 2

Table 3 resulted from nSEM analysis of model 2 identification with teachers' random intercept and slope. Meanwhile, Model 2 retained several significant parameter assumptions. The deviance value was 3017.808, while the AIC and BIC were 3069.808 and 3227.652, indicating a good fit. These values were considerably less than those generated by Model 1. Therefore, Model 2 was superior to Model 1 as the best in explaining the random effect of teachers.

The random effect was investigated based on the variance among teachers with different characteristics and competencies. This effect was also reflected in the magnitude of the variance component of a single latent variable at teacher-level, η_1^2 (teachers' ability). The value of the random intercept component in Table 3 was 0.0027, and this was less than the variance component of student motivation, which was 0.0597. Therefore, teachers similarly impacted students' motivation to learn mathematics.

Table 3 shows that the professional ability (x_4^2) of teachers contributes the most to the development of competence (1,132), while personality (x_2^2) contributed the least (0,477). For model identification, the loading factor for the attention indicator (y_1^1) was set to a value of 1. Self-confidence (y_3^1) and satisfaction (y_4^1) had the most and least significant influence on student learning motivation, with a value of 1.669 and 0.744, respectively.

Table 3. Results of Model 2

Parameter	Estimate	CI
Fix		
Student		
Attention intercept (ν_1^1)	3.169*	[3.135, 3.202]
Relevance intercept (ν_2^1)	3.044*	[3.001, 3.085]
Self-confidence intercept (ν_3^1)	3.065*	[3.009, 3.117]
Satisfaction intercept (ν_4^1)	3.539*	[3.501, 3.578]
Relevance $\left(\lambda_{2,1}^{1,1}\right)$	1.358*	[1.216, 1.521]
Self-Confidence $\left(\lambda_{3,1}^{1,1}\right)$	1.669*	[1.486, 1.879]
Satisfaction $\left(\lambda_{4,1}^{1,1}\right)$	0.744*	[0.589, 0.909]
Teacher		

Parameter	Estimate	CI
Pedagogy intercept (ν_1^2)	3.391*	[3.2749, 3.5064]
Personality intercept (ν_2^2)	3.259*	[3.1488, 3.3689]
Social intercept (ν_2^2)	3.562*	[3.4183, 3.7066]
Professional intercept (ν_2^2)	3.174*	[3.0290, 3.3200]
Personality $(\lambda_{2,1}^{2,2})$	0.477*	[0.1195, 0.8609]
Social $(\lambda_{2,1}^{2,2})$	1.003*	[0.6493, 1.4165]
Professional $(\lambda_{2,1}^{2,2})$	1.132*	[0.8165, 1.5146]
Teacher Competence (β_{12}^{22})	-0.070	[-0.0697, 0.0296]
Random		
Student		
Attention	0.0640	
Relevance	0.0604	
Self Confidence	0.1302	
Satisfaction	0.2134	
Motivation (ψ_{11}^{11})	0.0597*	[0.0487, 0.0723]
Teacher		
Pedagogy	0.0107	
Personality	0.0734	
Social	0.0678	
Professional	0.0450	
Teacher Intercept (ψ_{11}^{22})	0.0027*	[0.0010, 0.0073]
Teacher Competency (ψ_{22}^{22})	0.0943*	[0.0519, 0.1698]
Model Fit		
Deviance	3017.808	
AIC	3069.808	
BIC	3227.652	

This study was conducted to determine random effect of teachers on student motivation to study mathematics. Based on the outcomes of the analysis of the two previous nSEM models, model 2 was used for further investigation. The results of nSEM analysis were depicted in the path diagram in Figure 3. Model 2 was a teacher random intercept model, which is a single latent variable with teacher competence being a predictor. The influence of teachers' ability in Depok City had almost the same (homogeneous) effect on student motivation. However, motivation to learn mathematics among students had a considerable variance.

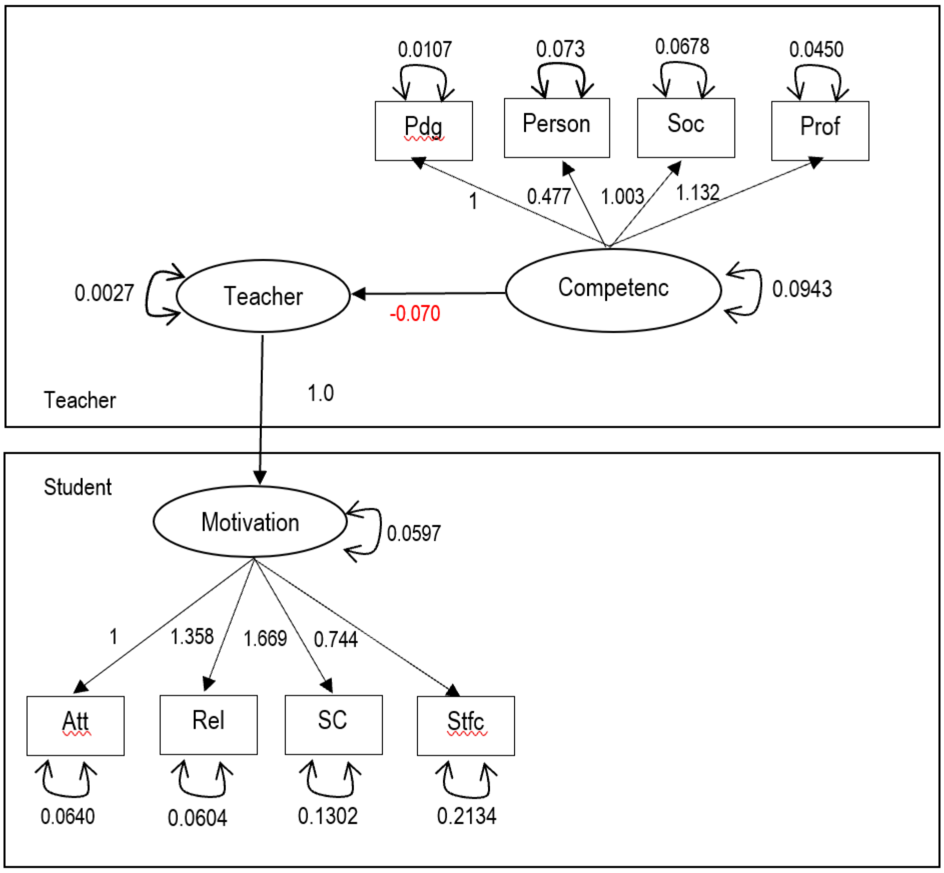

Figure 3. Model path diagram of nSEM analysis result

The Student Motivation to Learn Mathematics

The results of the measurement model analysis at the student level, which was the student motivation to learn mathematics, provided exciting findings. Student self-confidence in learning mathematics has become the leading indicator that builds motivation. The teacher is a pivotal figure influencing a student's self-confidence in acquiring mathematical knowledge (Pečiuliauskienė, 2023; Schukajlow et al., 2023). Developing confidence in mathematics entails more than simply solving equations or memorizing formulae; it involves cultivating a favorable mindset, perseverance, and a conviction in one's capacity to confront mathematical obstacles (Schoenfeld, 2016). Teachers must create an environment where students feel secure in sharing their ideas, can inquire without criticism, and have confidence in their potential to grow through hard work and determination (Darling-Hammond et al., 2020).

The motivational indicator to be improved is satisfaction, which is related to student assessment activities (Näsström et al., 2021). A positive and engaging learning experience can significantly affect students' attitudes toward the subject and their overall satisfaction with the learning process (Gray & Diloreto, 2016). Teachers should communicate learning objectives, expectations, and assessment criteria transparently to facilitate students' comprehension of the essential tasks (Orr et al., 2022). Offering a well-defined plan for the learning materials and evaluations enhances students' sense of assurance and contentment in their educational progression. Teachers promote and cultivate a feeling of assistance by urging students to seek assistance when necessary (Doño & Mangila, 2021). Teachers must also offer positive feedback consistently and acknowledge students' efforts and accomplishments.

Self-evaluation of mathematics learning can be made more effective and enjoyable by developing a system with various assessment types. The teacher's role is to take advantage of other indicators by increasing student interest and involvement in directly experiencing the application of mathematics or real-world tasks (Hong et al., 2021).

The Role of the Teacher on Student Motivation to Learn Mathematics

A more significant variance was reported in students' motivation to learn mathematics. This explained that the motivation to learn among students in a classroom was diverse. This result was supported by Aditomo and Felicia (2018), which found a significant quality gap between students at the same school. This phenomenon's potential was caused by the diversity of students' learning styles, interests, and aptitudes (Cardino & Ortega-Dela Cruz, 2020; Yotta, 2023). Some students may naturally find mathematics engaging, while others struggle or lack interest (Leyva et al., 2022). The effectiveness of teaching methods and the level of student engagement play a crucial role (Doño & Mangila, 2021). If the teaching methods do not accommodate varied learning styles or fail to make the subject matter engaging and pertinent, students may experience a decline in motivation (Wininger et al., 2019). According to (Roos, n.d.), diversity among students in mathematics classrooms does not necessarily require individualized teaching for each student. By being aware of diversity, teachers can develop a sensitivity towards equality in the classroom (Fine-Davis & Faas, 2014). In that sense, teachers put student's needs at the forefront of the explanations and tasks (Darling-Hammond et al., 2020). Students situated in such an environment and possessing such dispositions are more inclined to participate in mathematical reasoning, consequently attaining conceptual comprehension (Anyichie et al., 2023). Besides creating a positive student environment, teacher feedback is also essential. The nature of assessments and evaluations can impact motivation (Aust et al., 2023). If students regard assessments as excessively difficult or unjust, it can harm their drive to learn and excel (Ozan & Kıncal, 2018).

The following finding revealed that there was a slightly slight variance among teachers. This explained that teachers around Depok had relatively similar working performance in motivating the students to learn math. This should be considered by the teachers, schools, as well as local government since, in the prior finding, students' motivation to learn mathematics was varied. The slight variance of the teachers might also be caused by the same area where they teach, i.e., within Depok. The culture of this area understands that education can build teacher's approach to motivation (Robinson, 2022). Most educators, researchers, and policymakers suggested professional development that emphasizes an effective motivation strategy and provides instruments for teachers to adjust their approaches based on student's needs and individual differences (Irnidayanti & Fadhilah, 2023). Improving collaboration and knowledge-sharing among educators also contribute to more varied and effective motivation strategies in mathematics education (Alsaeed, 2022; Fraser et al., 2019; Mohn, 2018). Hettinger et al. (2023) proposed addressing mathematics teachers' educational practices to enhance self-efficacy in engaging students. This was achieved through direct interventions and in-service training designed for mathematics teachers (Ambussaidi & Yang, 2019), specifically in Depok Region. The teacher's expertise can create an entertaining classroom environment to stimulate the desire to learn (Al-Shara, 2015).

Referring to these findings, the teacher should make systematic efforts to increase student motivation (Houser & Frymier, 2009; Seidel et al., 2021; Sulkifli, 2021) by investigating the outset of learning mathematics based on academic performance and motivation to learn. It is crucial to do so because teachers are individuals who significantly impact fostering relationships based on mutual trust, motivating the process of information acquisition and learning. Moreover, in an independent curriculum, the mover teacher program is a government program to overcome this challenge (Helmi et al. (2022). This effort can support teachers in improving classroom learning by providing them with rights and responsibilities and legal frameworks for implementing progress and innovation in learning (Ngabiyanto et al., 2021).

CONCLUSION

This research focused on the diversity of teachers' abilities in motivating students to learn mathematics and investigated those students' diverse motivations in learning mathematics in the classroom. The findings of this research indicated that teachers' ability to motivate the students was slightly the same while students' learning motivation was relatively varied. The analysis data also revealed that students' various learning motivations were mainly caused by self-confidence; hence, teachers should consider this factor seriously. Increasing students' self-confidence would definitely affect their motivation. This aligns with government programs in independent curricula requiring teachers to improve student's learning motivation.

Several limitations should be considered in this research work. Limited areas in choosing the sample were one of them. More accurate research results, especially regarding a large diversity of teachers' abilities, might be found if the sample were selected from more expansive areas. Future research is also recommended to combine quantitative and qualitative methods on student motivation to gain a more comprehensive understanding of the factors influencing motivation.

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Declarations

Author Contribution	:	VE & AS: Conceptualization, Writing - Original Draft, Editing and Visualization Data collection and analysis. KS & UDS: Writing - Review & Editing and Methodology.
Conflict of Interest	:	The authors declare no conflict of interest.
Additional Information	:	Additional information is available for this paper.

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