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CAUSALITIES OF MOTIVATION, SELF-RELATED BELIEFS, AND STUDENT ENGAGEMENT TOWARDS HIGH SCHOOL STUDENTS' ACHIEVEMENT USING STRUCTURAL EQUATION MODELING

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ABSTRACT

Students' academic performances is an important factor as it affects students' chances of higher education and job opportunities. While cognitive factor (e.g., intelligence quotient) plays a major role in students' performances in academic environment, it does not guarantee students' academic achievement. Instead, researches shows that non-cognitive factor can affects student performance as well. Three non-cognitive factor that will be researched in this study are motivation, self-related beliefs, and engagement. Using Structural Equation Modeling (SEM) as the method of choice to accommodate the study of the factors. 699 of students' sample was taken from six public high school in Denpasar to conduct the research. SEM is used for its ability to analyze latent factors using measurement model and its ability to estimate multiple structural relation simultaneously. The model with a Goodness-of-fit (GFI) score of 0.981 confirms that Motivation does significantly directly affects student performances. Self-related beliefs and Engagement on the other hand significantly directly affects Motivation, hence the two constructs significantly indirectly affect student achievement.

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1. INTRODUCTION

High School students' score is an important factor. Score is used in higher education, scholarships, and in work industry as well as one of the factors to evaluate the recruitee. Students' score is found to be positively correlated with earnings [1]–[8]. Academic score become an important factor that cannot be ignored due to how it impacts the students' future. Research shows that there are other non-cognitive factors that affects students' academic performances [9]–[11]. Non-cognitive factors are widely defined as "personalities, patterns of thoughts, feelings, and behavior" [12]. Non-cognitive factors vary, depending on the subject of study. Educators often studies non-cognitive factors that directly affects students' academic success. Below are the three non-cognitive factors that will be used in the research.

Motivation [13] – [18] refers to the incentive for someone to take action. Those that are not incentivized to take action means they are not motivated [19]. Motivation in the literature of self-determination theory (SDT) from Deci dan Ryan, explains the concept of motivation and its most basic distinction between intrinsic and extrinsic motivation and how both of it affects the students' academic performances.

Self-related beliefs refers to one's perception of themselves [16][17][20][21]. Self-related beliefs can be put in many categories. The most research domain are self-concept dan self-efficacy towards students' academic performances. Self-concept focuses on broader domain as its multi-faceted by nature, as one's self-concept may differ between domains. Within that each domain lies a more specific skill or attribute, that's where self-efficacy contributes. Each aspect of the broader self-concept and the more specific self-efficacy both contribute in students' academic performances [22].

Student engagement [23]–[26] is defined as a continuous involvement in the learning process that are accompanied with positive reinforcement. Engagement based on Appleton, categorized into 4 domain, academic, behavioral, cognitive, dan psychological. Academic focuses on students work and test's performances, while behavioral aspect of the engagement focuses more on students class participation and attendances. Both academic and behavioral aspect of engagement is more easily gauged, on the other hand cognitive and psychological aspect is harder. As the former focuses on how students perceive the learning material and how they truly understands, while the latter speaks of how the student feel about their relationship within the school (friends, teacher, sense of belonging, etc.) [27].

Previous research have used motivation, self-related beliefs, and engagement to predict academic performances [17]. The research showed the affects of motivation and self-related beliefs towards mathematics and reading longitudinal score on 6^{th} and 8^{th} grade students through SEM. It is found that self-related beliefs have a great positive significance toward their score to the 6^{th} grader, and their score during the 6^{th} grade is found to have a correlation towards their score when they've become 8^{th} grader as well

[26] examine three longitudinal model, with a sample of 1,866 high school students for two years. It is found from SEM that motivation and self-concept have a positive correlation with students attitude towards school. Class participation and homework completion have a positive correlation with academic performances. Lastly, absenteeism correlate negatively with academic performances.

To deepen our understanding on the relationship of the aforementioned construct, a few problems arise. Firstly, the three non-cognitive factors mentioned does not have a quantitative metric to measure them. Secondly, there will be many relations that occurs simultaneously. To solve the problem above, Structural Equation Modeling (SEM) is used for its abilities to measure the construct using measurement model and also its abilities to handle multiple relations simultaneously. SEM is a combination of various multivariate technique, namely multiple regression and factor analysis. This allow the use of SEM to define a latent construct (motivation, self-related beliefs, engagement, an grade) simultaneously using indicators which in itself is defined by an equation each. SEM enables the calculation of the indicators to define a latent construct and to define the relationship between each of the construct. SEM enables multi-relationship of the construct to be deemed according to the proposed theory. SEM also enables the researcher to validate the contructs and their relationship simultaneously, allowing the researcher to see which indicator, construct, or pathed relationship that does not contribute to the model.

This research will add and to confirm existing theory of the proposed factor. In general asking the questions does motivation, self-related beliefs, and engagement affect students' grade. Does the proposed factor indeed affect it with enough statstical significance. To show this the SEM in the research will explore all existing relationship, whether it is direct or non direct. Determining the estimate of each relationship.

2. RESEARCH METHODS

2.1 Data Description

Samples are procured from 6 public high school in Denpasar through google questionnaires. Namely SMAN 2, 3, 4, 5, 6, and 8. The samples collected totalled into 699 students. There are 309 male students and 390 female students. 418 are from science major and 281 in social studies major. This data is procured in 2023.

2.2 Data Collection Techniques

Sampling method of choices is the cluster sampling method. Cluster sampling is a sampling method where groups or clusters are defined and then randomly selected **[28]**. Cluster sampling is often used when the groups within the population are have a greater variance than the variance between groups. Cluster sampling becomes the method of choice due to the school environment randomly arrange their students between classes, with no distinction of performances whatsoever.

Each schools provides 4 classes (that are considered as clusters) that are selected randomly out of 12 classes (most schools have 12 separate class for every grade).

2.3 Research Variables

Below in **Table 1** shows the four latent constructs and their own indicators with explanations.

Table 1. Research Variables

Notation	Constructs	Indicator Description
Motivation	**Motivation**	
X_1	MOT I	When I'm learning, I sometimes get totally absorbed
X_2	MOT II	Because learning is fun, I wouldn't want to give it up
X_3	MOT III	I study to increase my job opportunities
X_4	MOT IV	I study to ensure my future will be financially secure
Self-related Beliefs	**Self-related Beliefs**	
X_5	SC I	I do well in most of my tests
X_6	SC II	I learn things quickly in most of school subjects
X_7	SF I	I'm certain I can understand the most difficult material presented intext
X_8	SF II	I'm confident I can do excellent jobs on assignments and test
Engagement	**Engagement**	
X_9	ENG I	When I'm in class, I participate in class discussions
X_{10}	ENG II	I complete all of my assignments in due time
X_{11}	ENG III	When I do schoolwork, I check to see whether I understand what I'm doing
X_{12}	ENG IV	Most teachers at my school are interested in me as a person, not just as a student
Grade	**Grade**	
X_{13}	Bahasa	School subject of Bahasa Indonesia language
X_{14}	Bali	School subject of Balinese language
X_{15}	Inggris	School subject of English language
X_{16}	KWU	School subject of entrepreneurship
X_{17}	Mat	School subject of mathematics
X_{18}	PPKN	School subject of civic education
X_{19}	Penjas	School subject of physical exercise
X_{20}	Sejarah	School subject of history
X_{21}	Seni	School subject of art

2.4 Data Analysis

Analysis consists of evaluation of the measurement model and the structural model. After the evaluation the overall model is then evaluated once again using the goodness-of-fit.

2.4.1 Measurement Model

Figure 1 represents the four latent constructs in a form of reflective indicators, except for the latent construct Score where the construct is formed by formative indicators.

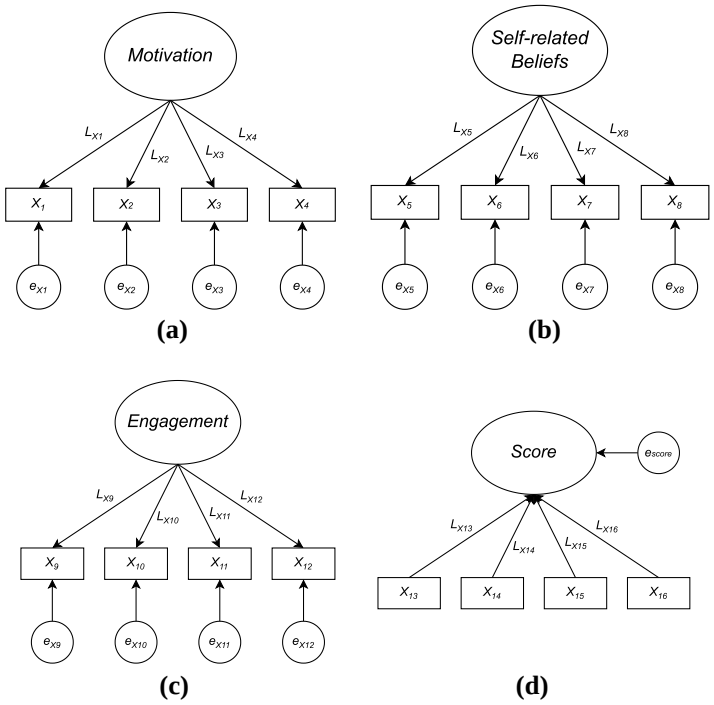

Figure 1. The Measurement Model of the Four Latent Constructs, (a) Motivation, (b) Self-related Beliefs, (c) Engagement, (d) Score

To evaluate constructs, indicators of each latent construct should converge or share the same variance proportion (convergent validity). A few ways to estimate convergent validity are through standardized factor loading. Standardized factor loading needs to be at least or greater than 0.5, even better if it is 0.7 or more [29].

Average Variance Extracted (AVE) is defined by the total of all squared standardized factor loadings (squared multiple correlations) divided by the number of items [29]. AVE are calculated as below:

$$\text{AVE} = \frac{\sum_{i=1}^{n} L_i^2}{n} \quad (1)$$

The L_i represents the standardized factor loading, and n is the number of items. AVE that is greater than 0.5 indicate a good convergence. A value that is less than 0.5 indicate there are more errors than information that are explained by the variance.

Realibility is a sign of convergent validity as well. Construct reliability (CR) is computed from the squared sum of factor loadings (L_i) for each construct and the sum of the error variance terms for a construct (e_i) [29]. CR are calculated as below:

$$\text{CR} = \frac{(\sum_{i=1}^{n} L_i)^2}{(\sum_{i=1}^{n} L_i)^2 + (\sum_{i=1}^{n} e_i)^2} \quad (2)$$

CR that's greater than 0.7 indicate a good reliability. Realibility between 0.6 to 0.7 are acceptable. A high CR value shows consistency, which means the indicator is representing the same thing [29].

2.4.2 Structural Model

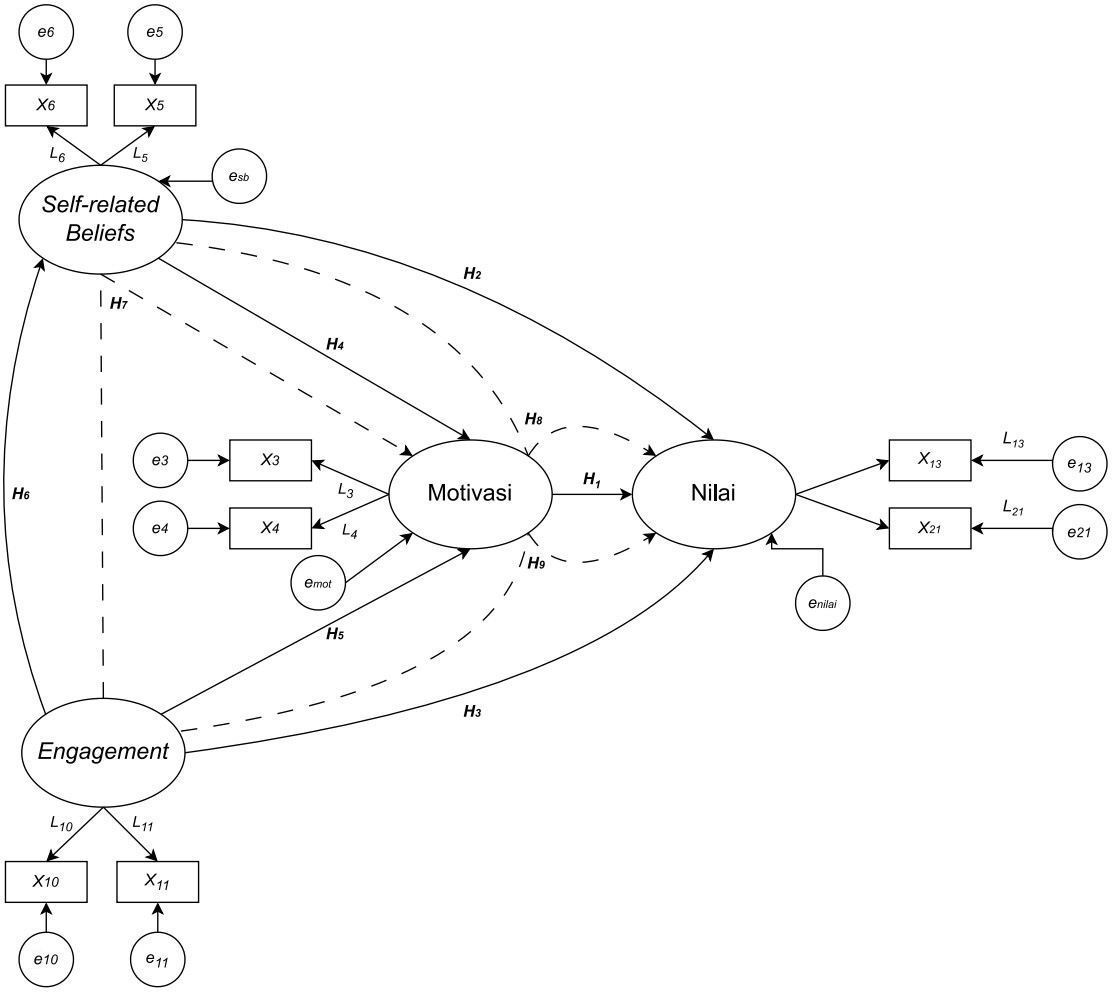

Figure 2. The Structural Model of The Four Latent Constructs

2.4.3 Goodness of Fit

Chi-Square (χ^2) GOF is the difference between observed and estimated covariance matrix (S dan Σ_k) represented by the equation below [29]:

$$\chi^2 = (\mathrm{N}-1)(\mathrm{S}-\Sigma_k) \tag{3}$$

Degree Of Freedom (df) means how much of information is available to estimate the model. where p is the total number of observed variables and k is the number of estimated parameters. Represented by the equation below [29]:

$$df = \frac{1}{2}[(p)(p+1)] - k \tag{4}$$

Absolute fit indices is direct method to evaluate a model, it gives an evaluation of how the data fit the models. Absolute fit indices does not compare the model to other model. A few indices that will be used are as follows:

Goodness-of-fit Index (GFI) where F_k is defined as the minimum fit function for SEM model that has been estimated using k, and where F_0 is defined as the fit function where the result will equal to if all parameters were zero, then GFI is defined simply as [29]:

$$\mathrm{GFI} = 1 - \frac{F_k}{F_0} \tag{5}$$

Root Mean Squared Error Of Approximation (RMSEA) compute the χ^2 from **Equation (3)**. The sample size (N) is used in the denominator to take it into account. The numerator is set to 0 if df_k exceeds χ^2 to avoid negative values **[29]**. RMSEA is defined as:

$$\text{RMSEA} = \sqrt{\frac{(\chi^2 - df_k)}{(N-1)}} \tag{6}$$

Incremental fit indices is different from absolute fit is that incremental fit compares the estimated models with its basic model. A few indices that will be used are as follows:

Tucker lewis index (TLI), as N and k refer to the null and specified models respectively. The TLI is not normed hence its values can fall below 0 or above 1 **[29]**. TLI is defined as:

$$\text{TLI} = \left[\frac{\left(\frac{X_N^2}{df_N}\right) - \left(\frac{X_k^2}{df_k}\right)}{\left(\frac{X_N^2}{df_N}\right) - 1}\right] \tag{7}$$

Comparative fit index (CFI). The subscript k represents df. The subscript N denotes values associated with the statistical null model. The equation is normed to values between 0 and 1 with higher values indicating better fit **[29]**. CFI is defined as:

$$\text{CFI} = 1 - \frac{(X^2 - df_k)}{(X_N^2 - df_k)} \tag{8}$$

3. RESULTS AND DISCUSSION

3.1 Convergent Validity

Cronbach alpha is a commonly used indicator to gauge wether not the construct are valid and reliable. Value that is lower than 0.6 are considered unacceptable. Value that is between $0.6 - 0.7$ are the minimum threshold that is still acceptable, while anything above 0.7 are considered good and indicate that contrcut are both valid and reliable **[29]**.

The **Table 2** show that both Motivation and Grade construct have a value of cronbach alpha above 0.8 indicating a goos signs of validty and reliability. Meanwhile Self-related Beliefs and Engagement constructs have a cronbach alpha value above 0.6 indicating validity and reliability that is still acceptable.

Table 2. Constructs Cronbach-Alpha Value

Construct	Cronbach-Alpha
Motivation	0.864
Self-related Beliefs	0.684
Engagement	0.686
Grade	0.805

Average variance extracted (AVE) equal or greater than 0.5 indicate on average, there are more variance that are explained by their latent construct compared to their errors. Construct reliability (CR) in the range of 0.6 - 0.7 or greater than 0.7 indicates that the construct is consistent and its indicators are convergent. Loading factors are recommended to have a minimum value of 0.7, loading factor that have a value less than 0.7 indicate that the indicators are unable to explain at least half the information on the model **[29]**.

Table 3. Convergent Validity of the Measurement Model

Construct	Item		Standardized loading factor			AVE	CR
			Estimate	Z - value	Sig.		
Motivation	MOT I	X_1	----------Removed----------			0.763	0.863
	MOT II	X_2	----------Removed----------				
	MOT III	X_3	0.915	–	–		
	MOT IV	X_4	0.831	10.610	0.000**		
Self-related Beliefs	SC I	X_5	0.791	–	–	0.529	0.690
	SC II	X_6	0.657	7.508	0.000**		
	SF I	X_7	----------Removed----------				
	SF II	X_8	----------Removed----------				
Engagement	ENG I	X_9	----------Removed----------			0.525	0.687
	ENG II	X_{10}	0.687	–	–		
	ENG III	X_{11}	0.760	6.528	0.000**		
	ENG IV	X_{12}	----------Removed----------				
Grade	Bahasa	X_{13}	0,887	–	–	0.681	0.803
	Bali	X_{14}	----------Removed----------				
	Inggris	X_{15}	----------Removed----------				
	KWU	X_{16}	----------Removed----------				
	Mat	X_{17}	----------Removed----------				
	PPKN	X_{18}	----------Removed----------				
	Penjas	X_{19}	----------Removed----------				
	Sejarah	X_{20}	----------Removed----------				
	Seni	X_{21}	0.759	11.114	0.000**		

* = Significant at 0.05
** = Significant at 0.005

Indicators within **Table 3** that do not have a loading factor score that is less than 0.7 are removed from the model. Indicators that are less than the required value didn't contribute enough information in the model or even worsen the fit of the model, hence said indicators are removed. The remaining indicators are then proceeded into the final model.

Motivation, Self-related Beliefs, Engagement, and Grade all have an AVE value of 0.763, 0.529, 0.525, and 0.681 respectively, this means there are more variance that are explained in the model by the four constructs rather than their errors.

Motivation, Self-related Beliefs, Engagement, and Grade all have a CR value of 0.863, 0.690, 0.687, and 0.803 respectively. All the four constructs have a CR value that is greater than 0.7, showing a consistency in the constructs.

Motivation affect Grades positively. For every one unit increase in motivation means an increase of 0.238 unit in academic performances. The third and fourth indicator have a loading factor value of 0.831 and 0.915, meanwhile the first and second indicator are removed for their below the criteria loading factors. The first and second indicator involves intrinsic motivation withing the realm of education. The third and fourth indicator involves extrinsic motivation that relates more with work opportunity that resulted from academic achievements. This shows from the taken sample that the students are more intrested in their studies due to external motivation, namely work opportunities that may resulted from their academic achievements rather than an internal interest in studying. However, both sides of the motivation still contribute to the student motivation which in turn affects the academic performances.

Self-related does not affect grades significantly within the model. The conclusion taken is not that self-related beliefs actually doesn't affects motivation or grades in any sort of way. Instead, self-related beliefs is not a commonly talked about topics within the context environment. The ambiguity of the concept or the lack of image that is presented by the questionaire inhibits the students understanding and undermine their answer through the questionaire. Which is why the model reflect poorly on the constructs

Engagement affects grade positively. For every one unit increase of the engagement construct means an increase 0.499 unit of the grade construct. The indicator shows a varied loading factors value with the second and third indicator values at 0.687 and 0.760 respectively. The third indicator represents the cognitive aspect from the construct, giving the highest contribution in terms of the loadin factors value. Meanwhile the fourth indicator that represents the psychological aspect of the indicator gives the lowest contribution to the loading factor. The two highest indicator which is the second and the third have a question that is directly tied with the studying and school work aspects, meanwhile the first and fourth indicator that relates with class involement and the relationship with the teachers. It is infered that the students focuses more on school task and their subject understanding rather than the class involvement and relationship with the teachers. As the school task and subject are more directly tied with their score, which in turn motivates the more to perform better rather than class participation and relationship with the teachers as those are not directly tied with their academic score.

Indicators X_3, X_5, X_{10}, and X_{13} is not estimated for their loading set to a fixed value (in this case 1.0). While all construct have sufficient AVE and CR, some of the indicators are removed especially for the Grade construct. The other subjects didn't contribute enough information to be proceeded in the final model. It is imporant to note the Grade construct only rely on X_{13} and X_{21} to represent the construct.

3.2 Discriminant Validity

Discriminant validity makes sure that the two constructs are unique. In a sense that the construct in a model captures what other construct do not capture or unable to explain. Unestablished discriminant validity shows that one construct might have an influence towards other construct and hence researchers cannot confirm the result from the model. Discriminant validity can be validated through the HTMT test, where the value of HTMT range from 0 to 1. The closer the value to 0, the more it indicates that two construct are unique that will be shown in **Table 4** .

Table 4. HTMT Value Between Constructs

Constructs			HTMT Score
Motivation	×	Self-related Beliefs	0.499
Motivation	×	Engagement	0.559
Motivation	×	Grade	0.359
Self-related Beliefs	×	Engagement	0.767
Self-related Beliefs	×	Grade	0.220
Engagement	×	Grade	0.427

The **Table 4** above shows the HTMT value between the four constructs from the measurement model. The HTMT value measures if the two constructs are actually unique to one another. A HTMT value that is less than one shows that the two constructs are empircally unique, showing that the other construct capture what the other construct doesn't capture and vice versa. A HTMT value that is greater than one instead shows that the two constructs are not unique to one another **[30]**.

All of the constructs that are shown in the **Table 4** shows a HTMT value that is all less than one. Showing that all four constructs are unique to one another. Meaning each construct do not overlapped information with one another. Compared to the rest pair of constructs, the pair of Self-related Beliefs and Engagement do show the highest HTMT score, albeit still not enough evidence to diprove of the discriminant validity. After confirming the model convergent and discriminant validity, researcher proceeds to evalute the model structural relations.

3.3 Structural Relations

Table 5 below shows all the existing structural relationship both in the direct or indirect manner. Table 5 reflect the hypothesis used in the research based on the nine structural relationship that existed in the model. Six of them being a direct relationship and the three of them being indirect.

Table 5. Structural Relations Hypothesis

Motivation → Grade	
H_{1_0}	Motivation does not significantly affects Grade
H_{1_1}	Motivation significantly affects Grade positively
Self-related Beliefs → Grade	
H_{2_0}	Self-related Beliefs does not significantly affects Grade
H_{2_1}	Self-related Beliefs significantly affects Grade positively
Engagement → Grade	
H_{3_0}	Engagement does not significantly affects Grade
H_{3_1}	Engagement significantly affects Grade positively
Self-related Beliefs → Motivation	
H_{4_0}	Self-related Beliefs does not significantly affects Motivation
H_{4_1}	Self-related Beliefs significantly affects Motivation positively
Engagement → Motivation	
H_{5_0}	Engagement does not significantly affects Motivation
H_{5_1}	Engagement significantly affects Motivation positively
Engagement → Self-related Beliefs	
H_{6_0}	Engagement does not significantly affects Self-related Beliefs
H_{6_1}	Engagement significantly affects Self-related Beliefs positively
Engagement → Self-related Beliefs → Motivation	
H_{7_0}	Engagement does not significantly affects Motivation through Self-related Beliefs
H_{7_1}	Engagement significantly affects Motivation positively through Self-related Beliefs
Self-related Beliefs → Motivation → Grade	
H_{8_0}	Self-related Beliefs does not significantly affects Grade through Motivation
H_{8_1}	Self-related Beliefs significantly affects Grade positively through Motivation
Engagement → Motivation → Grade	
H_{9_0}	Engagement does not significantly affects Grade through Motivation
H_{9_1}	Engagement significantly affects Grade positively through Motivation

Table 6 summarize from the Z-test from the nine hypothesis. Out of the nine hypothesis in Table 5, four out of the 9 hypothesis were found significant enough to reject their null hypothesis in Table 6. The four hypothesis are the causal effects from motivation to grade, engagement to grade, engagement toward motivation, and engagement toward self-related beliefs.

Table 6. Standardized Parameter Estimate

Structural relations					***Z − value***	***Sig.***	***Standardized Parameter Estimate***
Motivation	→	Grade			2.431	0.016*	0.238
Self-related Beliefs	→	Grade			1.713	0.088	−0.288
Engagement	→	Grade			2.735	0.007*	0.499
Self-related Beliefs	→	Motivation			1.377	0.170	0.197
Engagement	→	Motivation			2.793	0.006*	0.420
Engagement	→	Self-related Beliefs			7.469	0.000**	0.746
Engagement	→	Self-related Beliefs	→	Motivation	0.850	0.396	0.147
Self-related Beliefs	→	Motivation	→	Grade	0.734	0.464	0.047
Engagement	→	Motivation	→	Grade	1.284	0.200	0.100

* = Significant at 0.05.

** = Significant at 0.005

Motivation to grade and engagement to grade are proved to be significant, this aligns with [19]. While engagement toward motivation and engagement toward self-related beliefs when proved significant is also align with [31].

Below are Table 7, Table 8, and Table 9 which respectively repreesents the direct, indirect, and total effects of all exsiting relationship in the model.

Table 7. Direct Effects Between Construct

Structural Relations	Self-related Beliefs	Engagement	Motivation
Self-related Beliefs	–	0.746^{**}	–
Motivation	0.197	0.420^{*}	–
Grade	−0.288	0.499^{*}	0.238^{*}

Table 8. Indirect Effects Between Construct

Structural Relations	Self-related Beliefs	Engagement	Motivation
Self-related Beliefs	–	–	–
Motivation	–	0.147	–
Grade	0.047	−0.080	0.238

Table 9. Total Effects Between Construct

Structural Relations	Self-related Beliefs	Engagement	Motivation
Self-related Beliefs	–	0.746^{**}	–
Motivation	0.197	0.567	–
Grade	−0.242	0.419	0.238^{*}

Based on Table 7, Table 8, and Table 9, it is found that all the indirect effects in the model are not significant. Every indirect effect in the model is found to have very little to no effect on the overall model, hence it is considered insignificant. Instead all the significant causal relationship is found within the direct relationship such as motivation to grade, engagement to grade, engagement toward motivation, and engagement toward self-related beliefs. Engagement construct affects every other construct significantly, especially to Self-related Beliefs. This shows that Engagement within the school facilitates all other aspect positively. Self-related beliefs on the other hand is not significant towards Motivation or Grade.

3.4 Goodness-of-fit

Table 10 below summarize the various goodness-of-fit criteria for the SEM model. It is comprised by the Chi-square test, absolute fit measures, and the incremental fit measures. The details are as follows:

Table 10. The Model Goodness of Fit

Chi-Square (χ^2)	Value	Cutoff Value
Chi-square	$14.964\ (p = 0.381)$	> 0.05
Degrees of freedom	14	
Chi-square/df	1.069	< 3
Absolute Fit Measures		
Goodness fit index (GFI)	0.985	> 0.900
Root mean square error of approximation (RMSEA)	0.016	< 0.080
Standardized root mean square residual (SRMR)	0.028	< 0.080
Incremental Fit Measures		
Normed fit index (NFI)	0.980	> 0.900
Tucker Lewis index (TLI)	0.997	> 0.900
Comparative fit index (CFI)	0.999	> 0.900

Based on Table 10, The chi-square hypothesis are unable to found enough proof to reject its null hypothesis (Meaning the estimated and sampled covariance matrix are the same). Absolute fit measure indicate how well the data fit in the model through GFI, RMSEA, and SRMR. Incremental fit measures on

the other hand measures how well the model fit compared to its based model such as NFI, TLI, and CFI. All of the above measures and fit mentioned fufill their each and own criteria, meaning that the model is usable for further analysis.

4. CONCLUSIONS

Based off the previous shown results through SEM it is found that Motivation (0.238) and Engagement (0.499) significantly (through the Z-test) affect Grades positively directly while Self-related Beliefs does not have a direct significant effect toward Grades within the model. Between the three construct, Self-related Beliefs does not directly affects the Motivation construct. Meanwhile the Engagement construct does have a direct significant effects toward the Motivation (0.420) and Self-related beliefs construct (0.746).The model shows that there exist four significant direct effect out of the six proposed relation in the model. The model also shows that all three proposed indirect relation in the model is all insignificant and does not have a profound effect to their respective relationship. Further testing are recommended to provide more insights to the nature of the three non-cognitive factors. Different sets of model variation, includes the variation of mediation perhaps provide more insight, or the logintudinal data that could provide more insight. A recommended step is to clarify the questionaire indicator of the self-related beliefs and engagement, for it is not a very common subject among students and could hinder the students ability to precisely answers the questionaire and provide valuable data.

REFERENCES

[1] I. Walker and Y. Zhu, "Education, Earnings and Productivity: Recent UK Evidence.," *Labour Mark. Trends*, vol. 111, no. 3, pp. 145–152, 2003, [Online]. Available: http://kar.kent.ac.uk/3774/

[2] U. C. Akubuilo, K. K. Iloh, J. U. Onu, A. C. Ayuk, A. C. Ubesie, and A. N. Ikefuna, "Academic performance and intelligence quotient of primary school children in enugu," *Pan Afr. Med. J.*, vol. 36, no. 129, pp. 1–13, 2020, doi: 10.11604/pamj.2020.36.129.22901.

[3] C. Gabrieli, D. Ansel, and S. B. Krachman, "Ready To Be Counted: The Research Case for Education Policy Action on Non-Cognitive Skills," 2015, doi: 10.1080/22201009.2012.10872270.

[4] H. W. Marsh *et al.*, "Dimensional Comparison Theory: Paradoxical relations between self-beliefs and achievements in multiple domains," *Learn. Instr.*, vol. 35, pp. 16–32, 2015, doi: 10.1016/j.learninstruc.2014.08.005.

[5] K. Seashore Louis, *Cultivating Teacher Engagement: Breaking the Iron Law of Social Class*, no. 7. 2020. doi: 10.4324/9780203012543-16.

[6] J. S. Lee, "The relationship between student engagement and academic performance: Is it a myth or reality?," *J. Educ. Res.*, vol. 107, no. 3, pp. 177–185, 2014, doi: 10.1080/00220671.2013.807491.

[7] S. De Gale and L. N. Boisselle, "The Effect of POGIL on Academic Performance and Academic Confidence," *Sci. Educ. Int.*, vol. 26, no. 1, pp. 56–79, 2015.

[8] T. Honicke and J. Broadbent, "The influence of academic self-efficacy on academic performance: A systematic review," *Educ. Res. Rev.*, vol. 17, pp. 63–84, 2016, doi: 10.1016/j.edurev.2015.11.002.

[9] C. Ames and J. Archer, "Achievement Goals in the Classroom: Students' Learning Strategies and Motivation Processes," *J. Educ. Psychol.*, vol. 80, no. 3, pp. 260–267, 1988, doi: 10.1037/0022-0663.80.3.260.

[10] A. Bandura and D. H. Schunk, "Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation," *J. Pers. Soc. Psychol.*, vol. 41, no. 3, pp. 586–598, 1981, doi: 10.1037/0022-3514.41.3.586.

[11] B. Zimmerman, "Goal Setting and Self-Efficacy During Self-Regulated Learning," *Educ. Psychol.*, vol. 25, no. 1, pp. 3–17, 1990, doi: 10.1207/s15326985ep2501.

[12] L. Borghans, A. L. Duckworth, J. J. Heckman, and B. ter Weel, "The Economics and Psychology of Personality Traits," *J. Hum. Resour.*, vol. 43, no. 4, pp. 972–1059, 2008, doi: 10.1353/jhr.2008.0017.

[13] T. H. Bailey and L. J. Phillips, "The influence of motivation and adaptation on students' subjective well-being, meaning in life and academic performance," *High. Educ. Res. Dev.*, vol. 35, no. 2, pp. 201–216, 2016, doi: 10.1080/07294360.2015.1087474.

[14] M. D. Hanus and J. Fox, "Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance," *Comput. Educ.*, vol. 80, pp. 152–161, 2015, doi: 10.1016/j.compedu.2014.08.019.

[15] C. Gbollie and H. P. Keamu, "Student Academic Performance: The Role of Motivation, Strategies, and Perceived Factors Hindering Liberian Junior and Senior High School Students Learning," *Educ. Res. Int.*, vol. 2017, pp. 1–11, 2017, doi: 10.1155/2017/1789084.

[16] F. Guay, C. F. Ratelle, A. Roy, and D. Litalien, "Academic self-concept, autonomous academic motivation, and academic achievement: Mediating and additive effects," *Learn. Individ. Differ.*, vol. 20, no. 6, pp. 644–653, 2010, doi: 10.1016/j.lindif.2010.08.001.

[17] A. Habók, A. Magyar, M. B. Németh, and B. Csapó, "Motivation and self-related beliefs as predictors of academic achievement in reading and mathematics: Structural equation models of longitudinal data," *Int. J. Educ. Res.*, vol. 103, Jan. 2020, doi: 10.1016/j.ijer.2020.101634.

[18] K. A. Miller, E. L. Deci, and R. M. Ryan, "Intrinsic Motivation and Self-Determination in Human Behavior," *Contemp. Sociol.*, vol. 17, no. 2, p. 253, 1988, doi: 10.2307/2070638.
[19] R. M. Ryan and E. L. Deci, "Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions," *Contemp. Educ. Psychol.*, vol. 25, no. 1, pp. 54–67, 2000, doi: 10.1006/ceps.1999.1020.
[20] H. W. Marsh, O. Köller, U. Trautwein, O. Lüdtke, and J. Baumert, "Academic self-concept, interest, grades, and standardized test scores: Reciprocal effects models of causal ordering," *Child Dev.*, vol. 76, no. 2, pp. 397–416, 2005, doi: 10.1111/j.1467-8624.2005.00853.x.
[21] J. Suárez-Álvarez, R. Fernández-Alonso, and J. Muñiz, "Self-concept, motivation, expectations, and socioeconomic level as predictors of academic performance in mathematics," *Learn. Individ. Differ.*, vol. 30, pp. 118–123, 2014, doi: 10.1016/j.lindif.2013.10.019.
[22] R. J. Shavelson, J. J. Hubner, and G. C. Stanton, "Self-Concept: Validation of Construct Interpretations," *Rev. Educ. Res.*, vol. 46, no. 3, pp. 407–441, 1976, doi: 10.3102/00346543046003407.
[23] J. J. Appleton and B. Silberglitt, *Student engagement instrument as a tool to support the link between assessment and intervention: A comparison of implementations in two districts*. Elsevier Inc., 2019. doi: 10.1016/B978-0-12-813413-9.00022-X.
[24] U. Dogan, "Student engagement, academic self-efficacy, and academic motivation as predictors of academic performance," *Anthropologist*, vol. 20, no. 3, pp. 553–561, 2015, doi: 10.1080/09720073.2015.11891759.
[25] N. S. Galugu and S. Samsinar, "Academic self-concept, teacher's supports and students' engagement in the school," *J. Psikol. Pendidik. dan Konseling J. Kaji. Psikol. Pendidik. dan Bimbing. Konseling*, vol. 5, no. 2, p. 141, 2019, doi: 10.26858/jppk.v5i2.10549.
[26] J. Green, G. A. D. Liem, A. J. Martin, S. Colmar, H. W. Marsh, and D. McInerney, "Academic motivation, self-concept, engagement, and performance in high school: Key processes from a longitudinal perspective," *J. Adolesc.*, vol. 35, no. 5, pp. 1111–1122, 2012, doi: 10.1016/j.adolescence.2012.02.016.
[27] Skinner Ellen A and Belmont Michael J, "Motivation in the Classroom: Reciprocal Effects of Teacher Behavior and Student Engagement Across the School Year," *J. Educ. Psychol.*, vol. 85, no. 4, pp. 571–582, 1993.
[28] R. L. Scheaffer, R. L. Ott, and W. Mendenhall III, "Elementary Survey Sampling," *Technometrics*, 2011, doi: 10.1198/tech.2007.s481.
[29] J. F. Hair, W. C. Black, B. J. Babin, and R. E. Anderson, *Multivariate Data Analysis*. 2009.
[30] J. Henseler, C. M. Ringle, and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *J. Acad. Mark. Sci.*, vol. 43, no. 1, pp. 115–135, 2015, doi: 10.1007/s11747-014-0403-8.
[31] J. J. Appleton, S. L. Christenson, D. Kim, and A. L. Reschly, "Measuring cognitive and psychological engagement: Validation of the Student Engagement Instrument," *J. Sch. Psychol.*, vol. 44, no. 5, pp. 427–445, 2006, doi: 10.1016/j.jsp.2006.04.002.