Analysis of factors influencing students' participation in national and international competitions

Putri Bunga Setia[1], Andre Kurniawan[*1], Rizky Ema Wulansari[1], Eko Indrawan[1] and Gulzhaina Kuralbayevna Kassymova[2,3]

[1] Department of Mechanical Engineering, Faculty of Engineering, Universitas Negeri Padang, **Indonesia**
[2] Department of Pedagogy and Psychology, Abai Kazakh National Pedagogical University, **Kazakhstan**
[3] Institute of Metallurgy and Ore Beneficiation JSC, Satbayev university, **Kazakhstan**

*Corresponding author: andrekurniawan@ft.unp.ac.id
Received December 10th 2024; Revised February 13th 2025; Accepted February 18th 2025

Cite this https://doi.org/10.24036/jptk.v8i1.42623

Abstract: Higher education plays an important role in preparing students to become competent and competitive individuals. Furthermore, participating in academic competitions is a strategic means to foster innovative, collaborative, and competitive skills. This study employed Structural Equation Modeling (SEM) using Smart PLS (Partial Least Squares) software, a statistical technique suitable for analyzing complex relationships between variables. The analysis process involved two stages: measurement model and structural model. The analysis showed that the T-statistic for peer influence was 2.549, exceeding the threshold of 1.96, with a p-value of 0.011, below the 0.05 threshold for statistical significance. Similarly, the T-statistic for family influence was 3.803, also exceeding 1.96, with a p-value of 0.000, indicating a highly significant relationship. These findings highlight the important role of external factors, especially peer and family influence, in motivating students to participate in national and international competitions. Therefore, educational institutions need to implement targeted strategies to increase students' motivation and encourage active involvement in these competitions.

Keywords: National and international competition; Inhibiting factors; Achievements; Motivation

1. Introduction

In the current era of globalization, universities have a very important role in shaping the students' future, mainly in the fields of science and technology. Universities are educational institutions which are responsible for equipping students with the skills and competencies needed to compete in an increasingly competitive world. One effective way to develop these skills is by participating in science and technology competitions at both national and international levels. These competitions provide opportunities for students to hone their practical skills, critical thinking, and innovation (Zhang, 2024). In addition, student participation in competitions contributes to improve the nation's competitiveness on the global stage and it is also aligned with the university's mission which is to prepare students for international challenges.

However, the participation rate of Indonesian students in science and technology competitions, especially at international events, is still relatively low. Based on UNESCO report, only 6.3% of Indonesian students participate in international competitions (Simek & Stewart, 2024). Moreover,

Indonesia ranked 74th out of 79 countries in international science and math competition (Ismawati et al., 2023). This situation indicates a gap between the potential of Indonesian students and the available opportunities. The low participation of students in these competitions can be caused by various factors, including limited funds for travel and accommodation, lack of awareness regarding the valuable competitions, and low motivation due to intense competition and lack of confidence (Mebert et al., 2020; Nesbitt et al., 2025).

By participating in national and international competitions, students gain valuable experiences , impacting their future. This happens because students who actively participate tend to have high-spirited character, dedication, and greater knowledge than others (Konak et al., 2024). Students will also become highly qualified individuals, equipped with competitiveness, and prepared to compete globally (Green et al., 2023). Moreover, when students succeed in national and international competitions, it helps them enhance their skills, prepare for careers, and pursue further studies. Higher achievement received by students will strengthen the university's reputation and support its vision and mission (Acut & Antonio, 2023; Kassaw & Demareva, 2023; Radović et al., 2023). Universities play a strategic role in encouraging student participation in competitions (Bardorfer, 2024; Dierendonck et al., 2023). For instance, Carleton University in Canda has successfully increase student engagement through funding programs, intensive training, and mentorship from alumni (Berig et al., 2024; Quinn, 2019). This success which are consistently supported by university increases students' confidence and readiness to compete at higher levels. The existence programs from the university will support student competence and quality of learning (Abelha et al., 2020; Hart & Rodgers, 2024).

This research aims to identify the main barriers that prevent students from participating in science and technology competitions at both national and international levels. In addition, this research also explores students' motivations for participation and proposes strategies that universities can implement to overcome these barriers through more effective programs. By identifying the factors that hinder students' participation, the university can develop more targeted policies to increase students' involvement in competitions, equipping them with valuable experience to compete at the global level.

2. Methods

2.1 Research design

The research design applied an explanatory approach to analyze the relationship between variables using Structural Equation Modeling (SEM). By using SEM, the relationships that exist between variables could be visually examined. SMART-PLS software can analyze the factors that contribute to an event, without requiring normally distributed data and multivariate, and multicollinearity between exogenous variables. The data were collected through questionnaires, distributed online by using Google Form to year 1 to 3 students. In this study, an outer and inner model to analyze the data were used (J. F. Hair et al., 2021). Therefore, the relationship between internal factors and external factors to national competitions and international competitions could be found out. The research design is presented in Figure 1.

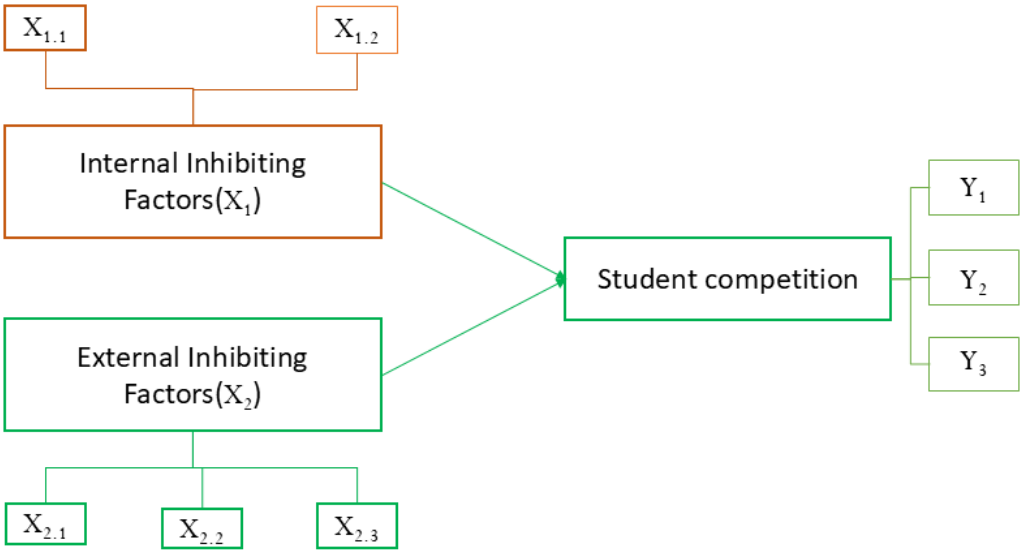

Figure 1. Theoretical framework

The population were year 1 to 3 students from the Department of Mechanical Engineering, Universitas Negeri Padang, Indonesia with a total population of 729 students. The strata consist of the 2021, 2022, 2023 batches from the S1 Mechanical Engineering Education Study Program, S1 Mechanical Engineering Study Program, and D3 Mechanical Engineering Study Program. The sample was determined by using the Solvin formula with 5% margin of error and 95% confidence level (Anugraheni et al., 2023).

$$n = \frac{N}{1+N\,(e)^2} = n = \frac{729}{1+729\,(0{,}05)^2} = 258{,}28 \approx 258 \quad (1)$$

The result above shows that 258.28 samples were obtained which then rounded to 258 samples or respondents. Furthermore, the number of samples for each group was determined by using the Proportional Stratified Random Sampling formula (Goyal et al., 2024; Singh & Gorey, 2019). The distribution number of population and sample can be seen in table 1.

Tabel 1. Population and Sample

Year	Population	Sample
First-year students	204	72
Second-year students	265	94
Third-year students	260	92
Total	**729**	**258**

2.2 Instruments

This study used questionnaire distributed using Google Form as the instrument. The purpose was to measure and collect numerical data in accordance with the indicator variables objectively (Rosidin et al., 2023). The questionnaire was developed based on the theory of learning motivation and had been validated by two educational validators. The validators declared a very valid to be used as a measuring tool in research (Kusmaryono et al., 2022). The research questionnaire lattice is presented in table 2.

Tabel 2. Instrument grid

No	Factor	Indicator	Question item
	External Factors (X_1)	Facilities and Infrastructure	4
1		Peer Influence	2
		Family Support	4
	Internal Factors (X_2)	Curiosity	5
2		Motivation	3
	Competition	Leadership	1
3		Soft Skill	1
		Problem Solving	1

2.3 Data analysis technique

Data analysis was carried out by using the Structural Equation Modeling (SEM) application with Smart PLS (Partial Least Square) software. SEM with PLS is an alternative technique in SEM analysis where the data used does not have to be multivariate normally distributed (J. Hair & Alamer, 2022; Memon et al., 2021). Partial Least Square (PLS) is a causal model that explains the influence between variables on construct variables (Ringle et al., 2023). In SEM-PLS, there is an Evaluation of the Measurement Model (Outer Model) which also refers to as the Outer Relation Measurement Model. It aims to evaluate the measurements in the model that has been created; thus it can explain how the influence between the indicators and underlying constructs.

The function of the measurement model (outer model) was to check the validity and reliability of a variable contained in this study. Validity test was used to assess the extent to which the measurement tool was able to measure something that had been determined to be measured. The reliability test of this model could be done by measuring Convergent Validity and Discriminant Validity. On the right hand, Composite Reliability was used to assess the reliability of a construct reflective indicators. The followings explain the steps mentioned above:

a. Convergent Validity: The loading factor value can be obtained by observing the measurement results of each indicator on the variable. In the early stage of measurement, a range of 0.5 to 0.6 is considered sufficient to continue the research (Cheung et al., 2024). The purpose of this measurement is to determine whether the relationship or influence between the indicator and the underlying construct variable is valid. If the average value of the Extended Variance (AVE) ≥ 0.50, then the indicator is considered valid (Hair et al., (2021).

b. Discriminant validity: Measurement at this stage can be seen using the Fornell-Larckel Criterion value and the concept of cross loading, measuring variables in reflection indicators. According to Hair et al., (2020), the cross-loading value must be greater than 0.70. The purpose of this measurement is to ensure that there is a difference between the latent model and other variables. Results are considered good if the Discriminant Validity test produces an AVE square root greater than the correlation between constructs of the model (Rönkkö & Cho, 2022).

c. Composite Reliability: Cronbach's Alpha and Composite Reliability are two methods used in testing indicators in measuring reflexive variables. However, if the test results of Cronbach's Alpha show a low level of reliability on the construct, then Composite Reliability should be used. This measurement aims to obtain the reliability value of a

variable. According to Hair et al., (2020), the expected value of Composite Reliability should be greater than 0.70.

Furthermore, there is an Inner Model measurement evaluation which is often referred to as structural model. This model explains how the latent variables in the study affect each other. In this structural model, there are several measurements need to be taken as the following:

a. R-Squere (R20) begins by looking at how well the endogenous constructs that have been built are able to predict these variables, which can be seen through the R-Square value. This measurement aims to assess the influence of exogenous variables on endogenous variables.
b. The purpose of this measurement is to assess how much influence exogenous variables have on endogenous variables. Changes in the R-Square value indicate changes in the level of prediction. It can be concluded that there are three criteria of R-Square value: 0.75, 0.50, and 0.25, indicating the extent to which the model is strong, medium, or weak (Ozili, 2022). In PLS, R-Square describes the extent to which the variables in the model can be explained by existing variation.

c. Path Coefficient Estimation aims to determine whether there is a positive or negative relationship between variables. This process can be evaluated using the Bootstrapping technique in smart PLS software (Benitez et al., 2020; Harris & Gleason, 2022). Path Coefficient testing has certain limitations

   - If the Path Coefficient value is >0, it indicates a positive relationship between the variables.
   - if the Path Coefficient value is <0, it indicates a negative relationship between the variables.

d. Furthermore, the purpose of hypothesis testing (Bootstrapping) is to determine whether there is a significant influence between the research constructs. Hypothesis testing involves comparing the values in the t-table with the t-statistic generated from the Bootstrapping procedure in smartPLS software. Hypothesis testing results can be declared as significant if the t-statistic value is greater than the t-table value. In hypothesis testing, if the t-statistic value is >1.96, it can be concluded that the result is significant. Otherwise, if the t-statistic value is <1.96, the test is considered insignificant (Kusmaryono et al., 2022).

A hypothesis is a statement that shows a conjecture about something being true. The hypothesis consists of two forms, including null hypothesis (H0) and alternative hypothesis (H1). The null hypothesis is a statement that indicates a population parameter with a certain value, which is often conveyed with expressions as no difference or no relationship. Meanwhile, the alternative hypothesis is a statement that implies the population parameter with a value differs from the null hypothesis. If the null hypothesis is proven, then the alternative hypothesis will be rejected, and vice versa (Kusmaryono et al., 2022). This research hypothesis is based on Theories of Motivation in Education, an Integrative Framework which states that curiosity, motivation, family, facilities and infrastructure, and peers affect interest in learning. From this theory, the researcher presents the results of the statistical hypothesis analysis in Table 3.

Tabel 3. Analysis technique on hypothesis

No	Hypothesis	Analysis technique
H0	Curiosity does not have a significant influence on student interest in participating in national and international competitions	SEM-PLS
H1	Curiosity has a significant influence on student interest in participating in national and international competitions	
H0	Motivation does not have a significant influence on student interest in participating in national and international competitions	SEM-PLS
H1	Motivation has a significant influence on student interest in participating in national and international competitions	
H0	Family does not have a significant influence on student interest in participating in national and international competitions	SEM-PLS
H1	Family has a significant influence on student interest in participating in national and international competitions	
H0	Facilities and infrastructure do not have a significant influence on student interest in participating in national and international competitions	SEM-PLS
H1	Facilities and infrastructure have a significant influence on student interest in participating in national and international competitions	
H0	Peers do not have a significant influence on student interest in participating in national and international competitions	SEM-PLS
H1	Peers have a significant influence on student interest in participating in national and international competitions	

3. Results

In this study, validity test was carried out to determine whether the construct has met the requirements to proceed to the next research stage. The results of this study revealed that the loading factor value was obtained by measuring each indicator on the variable. According to Cheung et al., (2024) in the early stages of measurement, if the loading factor value is around 0.5-0.6, these results are considered sufficient and research can be continued. In addition, according to (Ab Hamid et al., 2017), if the AVE (Average Variance Extracted) value is >0.50, the indicator is considered valid. Research results of factor loadings value is shown in Table 4.

After obtaining the factor loading values, the processed data from Smart PLS 4.1.0.0, 2024 was presented in tabular form to facilitate reading and interpretation. However, this table only provided static numerical information and was less intuitive to understand the relationship between variables visually. Therefore, the data from the table was then processed into a path graphic illustrating the loading factor in the form of a path diagram.

This visualization provided a clearer view of the relationship between latent variables and indicators, strengthening the interpretation of the analysis results. Thus, the path diagram serves as an effective tool for conveying the results compared to numerical table. This path diagram is presented in Figure 2.

Tabel 4. Factor loadings

Constructs	Items	Factor loadings					
Curiosty	KNN 1	0.849					
	KNN 2	0.916					
	KNN 3	0.838					
	KNN 4	0.881					
	KNN 5	0.865					
Family	KUA 1		0.926				
	KUA 2		0.679				
	KUA 3		0.904				
	KUA 4		0.888				
Motivation	MTI 1			0.837			
	MTI 2			0.901			
	MTI 3			0.899			
Student Competition	CPT1				0.901		
	CPT1				0.927		
	CPT1				0.902		
Facilities and Infrastructure	SAPRA 1					0.857	
	SAPRA 1					0.868	
	SAPRA 1					0.891	
	SAPRA 1					0.877	
Peer	TESE 1						0.925
	TESE 2						0.914

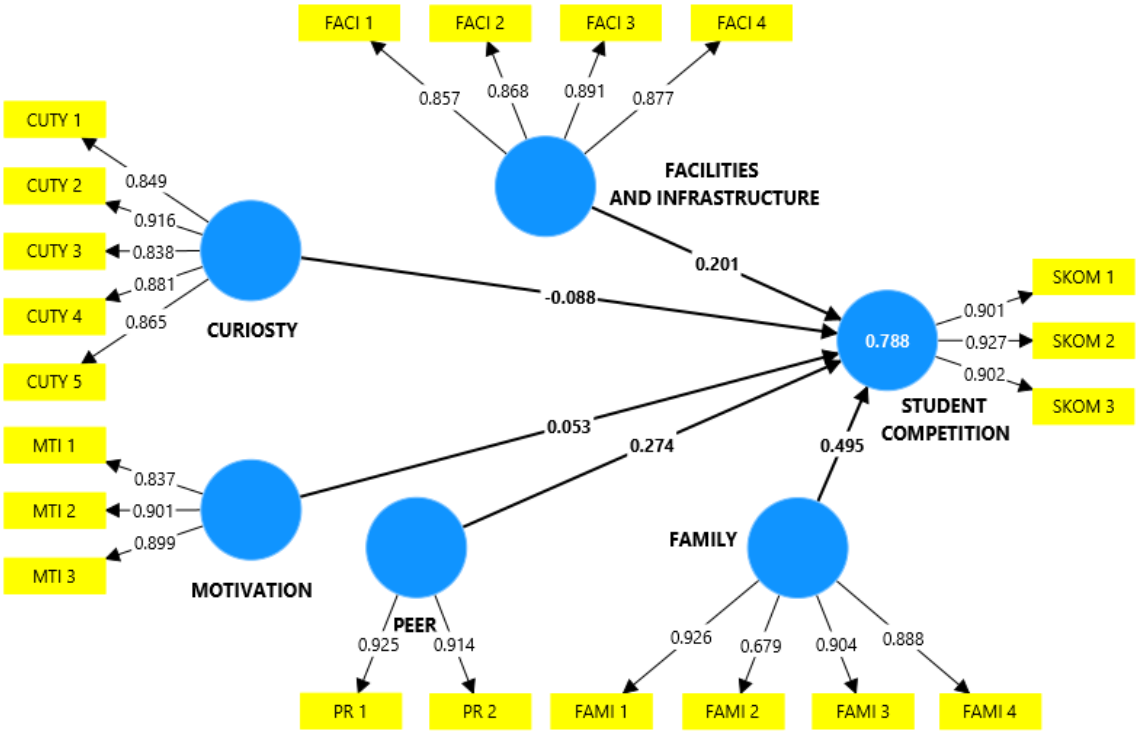

Figure 2. Path graphic loading factor

The cross loading helped to evaluate whether a construct had sufficient discriminant validity by comparing the loading value with other constructs. The loading value for a given construct should be higher than the loading value on other constructs. According to guidelines from J. F. Hair et al., (2020), the cross-loading value must be greater than 0.70. Cross Loading results are shown in table 5.

Tabel 5. Cross-loadings

	Curiosty	Family	Motivation	Student competition	Facilities and infrastructure	Peer
CUTY 1	0.849	0.677	0.564	0.594	0.610	0.553
CUTY 2	0.916	0.639	0.603	0.578	0.707	0.605
CUTY 3	0.838	0.623	0.644	0.583	0.714	0.639
CUTY 4	0.881	0.664	0.610	0.577	0.736	0.573
CUTY 5	0.865	0.645	0.644	0.597	0.763	0.650
FAMI 1	0.704	0.926	0.793	0.783	0.748	0.729
FAMI 2	0.481	0.679	0.512	0.525	0.543	0.513
FAMI 3	0.662	0.904	0.752	0.809	0.733	0.748
FAMI 4	0.684	0.888	0.684	0.773	0.727	0.727
MTI 1	0.624	0.645	0.837	0.593	0.710	0.592
MTI 2	0.633	0.807	0.901	0.735	0.749	0.642
MTI 3	0.607	0.674	0.899	0.665	0.758	0.669
SKOM 1	0.548	0.775	0.690	0.901	0.661	0.735
SKOM 2	0.649	0.836	0.671	0.927	0.721	0.736
SKOM 3	0.641	0.725	0.716	0.902	0.796	0.745
FACI 1	0.668	0.679	0.690	0.691	0.857	0.676
FACI 2	0.727	0.703	0.728	0.705	0.868	0.755
FACI 3	0.728	0.755	0.778	0.731	0.891	0.677
FACI 4	0.711	0.690	0.738	0.653	0.877	0.704
PR 1	0.653	0.786	0.640	0.771	0.754	0.925
PR 2	0.624	0.688	0.690	0.720	0.726	0.914

Based on the data showed in Table 5, the cross-loading values for each construct exceed 0.7. This indicates that all indicators used in the study are able to properly explain the latent variable in question and meet the validity standards. It is concluded that all items are valid and suitable in this study. This finding strengthens the belief that almost all measurement instruments used effectively measure latent variables, confirming their reliability and validity.

Tabel 6. Convergent validity

	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
Curiosty	0.919	0.940	0.757
Family	0.874	0.915	0.731
Motivation	0.853	0.911	0.773
Student Competition	0.896	0.935	0.828
Facilities and Infrastructure	0.896	0.928	0.762
Peer	0.818	0.916	0.846

In PLS-SEM using the SmartPLS application, the reliability of a construct is measured by two methods, including Cronbach's Alpha and Composite Reliability. However, if the value obtained using Cronbach's Alpha is too low, it is advisable to use Composite Reliability, which should have a minimum value exceeding 0.7 with the guidelines from J. F. Hair et al. (2020). The results of Composite Reliability and Cronbach's are shown in table 6. It can be seen that all variable values in reliability testing using Cronbach's Alpha and Composite Reliability are above 0.7. Validity testing using AVE also shows a value of more than 0.5. Thus, it can be concluded that the tested variables have sufficient validity and reliability, allowing for further structural model (Inner Model).

The structural model in SEM using PLS is assessed by testing the R-Squared (R^2) and the significance of the Path Coefficient through estimation. According to the criteria set, an R-Squared value of 0.75 indicates a strong model, 0.50 indicates a medium model, and 0.25 indicates a weak model, as described by Ozili (2022).

Tabel 7. Convergent validity

	R-squeare	R-square adjusted
Student Competition	0.788	0.780

In Table 7, the R-Square value obtained for competition variable is 0.788. These results indicate that intrinsic inhibiting and extrinsic inhibiting factors provide an influence of 79% on the competition variable. Thus, these factors have a significant influence. The direct effect of 78% indicates that half of the variation in national and international competition is influenced by the inhibiting factors. The R-square value of 0.788 for the national and international competition variables shows that they are strongly influenced by the inhibiting factors, covering more than half of the variation. This finding highlights the need to reduce inhibiting factors in enhancing the effectiveness of the national and international competition.

The Path Coefficient testing stage determined whether a variable had a positive or negative relationship with other variables. There are certain conditions on the Path Coefficient value, including if the value is >0, it indicates that the variable has a positive relationship with other variables, and if the Path Coefficient value is less than <0, it indicates a negative relationship with other variables. The Path Coefficient results are shown in table 8.

Tabel 8. Path coefficient

	Curiosty	Family	Motivation	Student competition	Facilities and infrastructure	Peer
Curiosty				-0.088		
Family				0.495		
Motivation				0.053		
Student Competition						
Facilities and Infrastructure				0.201		
Peer				0.274		

Table 8 shows the relationship between various inhibiting factors and variable Y. Curiosity indicator has a value of -0.088 showing a negative relationship with Y. In contrast, Family (0.495), Motivation (0.053), Facilities and Infrastructure (0.201), and Peers (0.274) show positive

relationships with Y. This concludes that Family, Motivation, Facilities and Infrastructure, and Peers contribute positively to the development of variable Y. However, the Curiosity indicator shows a more complex relationship, as its negative influence may give an impact based on different contexts and stages of the process being studied.

Hypothesis testing was done to analyze the direct effect. PLS-SEM does not assume that the data is normally distributed, which means that parametric significance tests (e.g., as used in regression analysis) are not required. Instead, PLS-SEM relies on a nonparametric bootstrap procedure to test the significance of the Path Coefficient estimates in PLS-SEM. The significance test in the SEM model with PLS aims to analyze the impact of exogenous variables on endogenous variables. The bootstrap resampling method in this study highlights that significance is accepted if the t-statistic significance value is greater than 1.96 or the P-values are less than 0.05 (Kusmaryono et al., 2022). Hypothesis testing to examine the direct effect was conducted by analyzing the t-statistic value and P-values generated from the Inner Model. The the results of the direct effect hypothesis test are presented in table 9.

Tabel 9. Significance test (Bootstrapping)

	Original sample	Sample mean	Standard deviation	T-statistics	P values
Curiosty -> Student Competition	-0.088	-0.095	0.084	1.054	0.292
Facilities and Infrastructure -> Student Competition	0.201	0.187	0.107	1.873	0.061
Motivation -> Student Competition	0.053	0.063	0.082	0.649	0.516
Peer -> Student Competition	0.274	0.282	0.108	2.549	0.011
Family -> Student Competition	0.495	0.500	0.130	3.803	0.000

Based on Table 9, the determination of significance is explained as follows:

a. Curiosity does not have a significant impact in encouraging students of the Department of Mechanical Engineering UNP to participate in national and international competitions. Based on Table 9, the T-statistic value of 1.054 is smaller than 1.96, and the p-value of 0.292 is greater than 0.05. These results indicate that there is no significant influence between Curiosity and National and International Competitions.
b. Motivation does not have a significant impact in encouraging students of the Department of Mechanical Engineering UNP to participate in national and international competitions. Based on Table 9, the T-statistic value of 0.649 is smaller than 1.96, and the p-value of 0.516 is greater than 0.05. These results indicate that there is no significant influence between Motivation and National and International Competitions.
c. Family has a significant impact on national and international competitions to students of the Department of Mechanical Engineering UNP. Based on Table 9, the T-statistic value of 3.803 is greater than 1.96, and the p-value of 0.000 is smaller than 0.05. These results indicate that there is a significant influence between Family and National and International Competitions.
d. Peers have a significant impact in encouraging students of the Department of Mechanical Engineering UNP to participate in national and international competitions. Based on Table 9, the T-statistic value of 2.549 is greater than 1.96, and the p-value of 0.011 is smaller than 0.05. These results indicate that there is a significant influence between Peers and National and International Competitions.
e. Facilities and Infrastructure do not have a significant impact in encouraging students of the Department of Mechanical Engineering UNP to take part in national and international

competitions. Based on Table 9, the T-statistic value of 1.873 is smaller than 1.96, and the p-value of 0.061 is greater than 0.05. These results indicate that there is no significant influence between Facilities and Infrastructure and National and International Competitions.

Tabel 10. Hypothesis decision result

Hypothesis	Path Coefficient	T Statistics	PValues	Decision
H1	-0.088	1.054	0.292	Rejected
H2	0.495	3.803	0.000	Accepted
H3	0.053	0.649	0.516	Accepted
H4	0.201	1.873	0.061	Accepted
H5	0.274	2.549	0.011	Accepted

Based on the table 10 above, H3 and H4 can be interpreted that the hypotheses are accepted because they have positive relationship direction but do not have significant values. In line with them, H2 and H5 mean that the hypotheses are accepted because they have positive and significant relationship direction values. Conversely, H1 means that the hypothesis is rejected. The discussion about the acceptance and rejection of the hypotheses is discussed more clearly as follows:

H1: The results of the analysis show that curiosity has a negative effect in inhibiting students of the Department of Mechanical Engineering UNP from participating in national and international competitions. This effect is not statistically significant with the Path Coefficient value of -0.088, a T Statistic value of 1.054 and a P value of 0.292. Therefore, hypothesis H1 cannot be accepted because of the negative relationship of the variables. Research by Fitria (2024); Henriksen et al. (2020) states that creativity can help a person explain and describe abstract concepts by involving skills such as curiosity. It can be interpreted that the curiosity needed does not have a significant influence to be an obstacle for students to participate in the national and international competitions, but this obstacle cannot be used as a general benchmark for the low participation of students in participating on national and international competitions.

H2: The results of the analysis show that family has a positive effect in inhibiting students of the Department of Mechanical Engineering UNP for national and international competitions. This effect is statistically significant with a Path Coefficient of 0.495, a T Statistic value of 0.649, and a P value of 0.000. The hypothesis in this study can be accepted because there is a positive and significant relationship that proves the Family variable has a positive and significant effect in inhibiting students of the Department of Mechanical Engineering UNP from participating in national and international competitions. Acceptance of this hypothesis is in line with research by Descals-Tomás et al. (2021); Ma et al. (2024) which shows that family support often plays an important role in motivating creativity. Descals-Tomás et al. (2021); Ma et al. (2024) emphasizes that the social environment, including family support, can greatly influence an individual's level of creativity. Support from families can provide emotional encouragement, resources, and an environment conducive to the development of creative ideas. The research results show a positive relationship between the role of family and hindering students' participation in national and international competitions. This can be interpreted as a lack of family support playing a role in reducing students' participation in these competitions. One of the reasons why a lack of family support can lead to a lack of student participation in national and international competitions is because of the student's pressure for other activities, including parents or siblings encouraging the student to focus on other more important activities, such as academic studies or part-time jobs and family

work, so this can reduce the student's personal time and energy to participate in national and international competitions.

H3: The results of the analysis show that motivation has a positive effect in inhibiting students of the Department of Mechanical Engineering UNP from participating in national and international competitions. This result is not statistically significant with a Path Coefficient value of 0.053, a T Statistic value of 3.803, and a P-value of 0.516. The hypothesis in this study is accepted because the Path Coefficient value is 0.053 which is greater than 0 where this value indicates a positive relationship between curiosity and national and international competitions. Even though it is small, this is in accordance with the hypothesis proposed, which is motivation has a positive effect in inhibiting students of the Department of Mechanical Engineering UNP from participating in the national and international competitions. This acceptance is in line with research by Tan et al. (2019) which suggests that intrinsic motivation supports creative engagement. In the Self-Determination Theory (SDT) developed by Deci and Ryan, intrinsic motivation refers to the desire to do something because of the interest and satisfaction inherent in the activity, rather than because of external pressures or incentives. Typically, intrinsic motivation is considered a key driver of deep and creative engagement in a wide range of activities, including in the context of education and self-development. The results obtained in this study are that the lack of intrinsic motivation can be an obstacle for students of the Department of Mechanical Engineering UNP to participate on national and international competitions for several reasons, including the existence of external pressures and expectations, a mismatch between personal interests and programs on national and international competitions, and lack of external recognition.

H4: The results of the analysis show that facilities and infrastructure through Problem Solving as a mediating variable have a positive effect in inhibiting students of the Department of Mechanical Engineering UNP from participating in national and international competitions. This effect is not statistically significant with a Path Coefficient value of 0.201, a T Statistic value of 1.873 and a P value of 0.061. Hence, hypothesis H4 can be accepted because of the positive relationship of the variables. Research by Isaksen (2023) states that an adequate work environment usually supports creativity. It can be interpreted that the facilities and infrastructure needed do not have a significant influence to be an obstacle for students to participate on national and international competitions, but this obstacle cannot be used as a general benchmark for the low participation of students in participating on national and international competitions.

H5: The results of the analysis show that peers have a positive effect on inhibiting students of the Department of Mechanical Engineering UNP from participating in national and international competitions. This effect is statistically significant with a Path Coefficient value of 0.274, T Statistic value of 2.549, and P values of 0.011. The hypothesis in this study can be accepted because there is a positive and significant relationship that proves the hypothesis of Peers through Problem Solving as a mediating variable has a positive effect in inhibiting students of the Department of Mechanical Engineering UNP from participating and National and international competitions. Acceptance of this hypothesis is also based on the results of research conducted Descals-Tomás et al. (2021); Ma et al. (2024), supporting the relationship between peer support and creativity. It is concluded in this study that the role of peers has a positive impact in inhibiting students' interest in participating in national and international competitions, this positive impact is due to the lack of support provided by peers or fellow students for all activities carried out by these students.

4. Discussion

This study identifies two categories of factors influencing students' participation in national and international competitions. Internal factors comprise Motivation and Curiosity, while external factors include Peer Influence, Family, and Facilities and Infrastructure. The Curiosity indicator demonstrates a negative and statistically insignificant effect, implying that this factor does not significantly influence students' participation in competitions. These findings align with previous research, which suggests that creativity aids individuals in explaining and visualizing abstract concepts by incorporating skills such as curiosity (Palmiero, 2020; Roberts et al., 2021). Consequently, curiosity does not significantly hinder student participation in competitions, although this limitation should not be universally interpreted as the primary cause of low participation rates.

The motivation indicator shows that motivation has a positive but insignificant effect. Acceptance of this hypothesis is in line with research by Chauhan et al., (2024), which shows that family support often plays an important role in motivating creativity and emphasizes that the social environment, including family support, can greatly affect the level of individual creativity. Support from the family can provide emotional encouragement, resources, and an environment conducive to the development of creative ideas. Meanwhile, from the results of the research, the facilities and infrastructure indicator also have a positive but insignificant effect. So, the facilities and infrastructure hypothesis can be accepted because of the positive relationship of the hypothesis. This research is in line where according to Lee & Lee, (2023) which states that an adequate work environment usually supports creativity. It can be interpreted that the facilities and infrastructure needed do not have a significant influence to become an obstacle for students to participate in the National Competition.

In addition, the hypothesis regarding family indicators has a positive and significant effect, which proves the hypothesis that family has an effect in inhibiting students from participating in national and international competitions. Acceptance of this hypothesis is also in line with research by Hall (2020) which shows that intrinsic motivation supports creative engagement. In the Self-Determination Theory (SDT) theory developed by Deci and Ryan, intrinsic motivation refers to the desire to do something because of the interest and satisfaction inherent in the activity, not because of external pressures or incentives. Typically, intrinsic motivation is considered a key driver of deep and creative engagement in a wide range of activities, including in the context of education and self-development.

Meanwhile, peers show an acceptable hypothesis because there is a positive and significant relationship that proves the hypothesis that peers have a positive effect in inhibiting students of the Department of Mechanical Engineering UNP from participating in the national and international competition. Acceptance of this hypothesis is also based on the results of research conducted by Pan et al. (2024); Yang & Xiang (2025), supporting the relationship between peer support and creativity. Therefore, it is concluded in this study that the role of peers has a positive impact in inhibiting students interest in participating in the national and international competition. This positive impact is due to the lack of support provided by peers or fellow students for all activities carried out by these students.

This study was conducted in a limited sample scope, therefore it is advised for further research to further expand the scope of the sample to get more comprehensive results. It is also suggested for the Department to be able to work with the University to implement concrete steps to provide more detailed information, such as the benefits given to students if they get achievements when

participating in the national and international competition. With these steps, it is expected to create an environment that supports students of the Department of Mechanical Engineering UNP to be more actively involved in various self-development programs, including national and international competitions. Consequently, this research can contribute to the university and be a reference for public policy makers.

5. Conclusion

This study found that family and peer support in the educational environment are the main factors that influence students' participation in academic and extracurricular competitions. To support this, universities can expand mentoring programs and provide more academic awards and scholarships for outstanding students so that students who experience these policies share their experiences with other students. This will increase the interest of peers in their educational environment to participate. Meanwhile, the role of the family is crucial in providing motivation and learning facilities at home. In addition, policy makers are expected to design educational policies that strengthen the mentoring system for students who want to compete.

However, this study has limitations because it was only conducted at the Department of Mechanical Engineering UNP, so the results cannot be generalized to students from other departments, although they are still within the scope of the same university. Therefore, future research can expand the scope by involving various departments or different universities. This broader study will provide a more comprehensive understanding and can be used as a basis for more thorough decision-making. By understanding the factors that contribute to student participation, universities and policy makers can design more effective strategies to increase student engagement in academic and extracurricular activities. The findings of this study provide valuable insights in supporting the development of a more competitive and globally prepared younger generation.

Author's declaration

Author contribution

Putri Bunga Setia: Developed the methodology, Conducted the investigation, and wrote the original manuscript; **Eko Indrawan** and **Rizky Ema Wulansari**: provided resources, analysed the data and contributed to the writing of the original manuscript; **Andre Kurniawan**: revised the manuscript.

Funding statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Acknowledgements

Thank you to the Department of Mechanical Engineering Universitas Negeri Padang for giving the opportunity and support to conduct this research.

Conflict of interest

The authors declare that there are no competing interests related to the research or publication of this article.

Ethical clearance

This research is not funded by any person or organization. The Permission of conducting this research has been issued by the Department of Mechanical Engineering number 1850/UN35.2.1/LT/2024. Lecturers and students have agreed to be subjects in this study and are willing for the data provided to be published. Their involvement in this research is in accordance with the Declaration of Helsinki.

AI statement

This article is the author's original work with no sections or figures are generated by AI. The English use has been checked verified by an English language expert.

Publisher's and Journal's note

Universitas Negeri Padang as the publisher, and the Editor of Jurnal Pendidikan Teknologi Kejuruan state that there is no conflict of interest towards this article publication.

References

Ab Hamid, M. R., Sami, W., & Mohmad Sidek, M. H. (2017). Discriminant Validity Assessment: Use of Fornell & Larcker criterion versus HTMT Criterion. *Journal of Physics: Conference Series*, *890*, 012163. https://doi.org/10.1088/1742-6596/890/1/012163

Abelha, M., Fernandes, S., Mesquita, D., Seabra, F., & Ferreira-Oliveira, A. T. (2020). Graduate Employability and Competence Development in Higher Education—A Systematic Literature Review Using PRISMA. *Sustainability*, *12*(15), 5900. https://doi.org/10.3390/su12155900

Acut, D., & Antonio, R. (2023). Effectiveness of Science-Technology-Society (STS) approach on students' learning outcomes in science education: Evidence from a meta-analysis. *Journal of Technology and Science Education*, *13*(3), 718. https://doi.org/10.3926/jotse.2151

Anugraheni, T. D., Izzah, L., & Hadi, M. S. (2023). Increasing the Students' Speaking Ability through Role-Playing with Slovin's Formula Sample Size. *Jurnal Studi Guru Dan Pembelajaran*, *6*(3), 262–272. https://doi.org/10.30605/jsgp.6.3.2023.2825

Bardorfer, A. (2024). Fostering Students' Active Participation in Higher Education: The Role of Teacher-student Rapport. *Athens Journal of Education*, *11*(3), 227–246. https://doi.org/10.30958/aje.11-3-4

Benitez, J., Henseler, J., Castillo, A., & Schuberth, F. (2020). How to perform and report an impactful analysis using partial least squares: Guidelines for confirmatory and explanatory IS research. *Information & Management*, *57*(2), 103168. https://doi.org/10.1016/j.im.2019.05.003

Berig, F., Kulturel-Konak, S., & Konak, A. (2024). Exploring the Transformative Influence of Student Innovation Competitions and Programs: Insights from their Organizers. *2024 IEEE Integrated STEM Education Conference (ISEC)*, 1–6. https://doi.org/10.1109/ISEC61299.2024.10664769

Chauhan, S., Chauhan, K., Singh, S., Mahlawat, S., Kumar, V., & Singh, S. (2024). Analyzing family support mediating role between motivational factors and sustainable entrepreneurial intentions: A study on university students. *Sustainable Technology and Entrepreneurship*, *3*(3), 100076. https://doi.org/10.1016/j.stae.2024.100076

Cheung, G. W., Cooper-Thomas, H. D., Lau, R. S., & Wang, L. C. (2024). Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and best-

practice recommendations. *Asia Pacific Journal of Management*, *41*(2), 745–783. https://doi.org/10.1007/s10490-023-09871-y

Descals-Tomás, A., Rocabert-Beut, E., Abellán-Roselló, L., Gómez-Artiga, A., & Doménech-Betoret, F. (2021). Influence of Teacher and Family Support on University Student Motivation and Engagement. *International Journal of Environmental Research and Public Health*, *18*(5), 2606. https://doi.org/10.3390/ijerph18052606

Dierendonck, C., Tóth-Király, I., Morin, A. J. S., Kerger, S., Milmeister, P., & Poncelet, D. (2023). Testing associations between global and specific levels of student academic motivation and engagement in the classroom. *The Journal of Experimental Education*, *91*(1), 101–124. https://doi.org/10.1080/00220973.2021.1913979

Fitria, T. N. (2024). Creative Writing Skills in English: Developing Student's Potential and Creativity. *EBONY: Journal of English Language Teaching, Linguistics, and Literature*, *4*(1), 1–17. https://doi.org/10.37304/ebony.v4i1.10908

Goyal, A., Arora, S., & Goyal, A. (2024). A stratified modified probability proportional to size sampling technique. *Communications in Statistics - Theory and Methods*, *53*(23), 8525–8542. https://doi.org/10.1080/03610926.2023.2292969

Green, S., Sanczyk, A., Chambers, C., Mraz, M., & Polly, D. (2023). College and Career Readiness: A Literature Synthesis. *Journal of Education*, *203*(1), 222–229. https://doi.org/10.1177/00220574211002209

Hair, J., & Alamer, A. (2022). Partial Least Squares Structural Equation Modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. *Research Methods in Applied Linguistics*, *1*(3), 100027. https://doi.org/10.1016/j.rmal.2022.100027

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110. https://doi.org/10.1016/j.jbusres.2019.11.069

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *An Introduction to Structural Equation Modeling* (pp. 1–29). https://doi.org/10.1007/978-3-030-80519-7_1

Hall, C. M. (2020). The Impact of Family Engagement on Student Achievement. *Networks: An Online Journal for Teacher Research*, *22*(2). https://doi.org/10.4148/2470-6353.1327

Harris, J. E., & Gleason, P. M. (2022). Application of Path Analysis and Structural Equation Modeling in Nutrition and Dietetics. *Journal of the Academy of Nutrition and Dietetics*, *122*(11), 2023–2035. https://doi.org/10.1016/j.jand.2022.07.007

Hart, P. F., & Rodgers, W. (2024). Competition, competitiveness, and competitive advantage in higher education institutions: a systematic literature review. *Studies in Higher Education*, *49*(11), 2153–2177. https://doi.org/10.1080/03075079.2023.2293926

Henriksen, D., Richardson, C., & Shack, K. (2020). Mindfulness and creativity: Implications for thinking and learning. *Thinking Skills and Creativity*, *37*, 100689. https://doi.org/10.1016/j.tsc.2020.100689

Isaksen, S. G. (2023). Assessing the Work Environment for Creativity and Innovation: Building on Mathisen and Einarsen's Review (2004). *Creativity Research Journal*, *35*(2), 227–253. https://doi.org/10.1080/10400419.2022.2112837

Ismawati, E., Hersulastuti, H., Amertawengrum, I. P., & Anindita, K. A. (2023). Portrait of Education in Indonesia: Learning from PISA Results 2015 to Present. *International Journal of Learning, Teaching and Educational Research*, *22*(1), 321–340. https://doi.org/https://doi.org/10.26803/ijlter.22.1.18

Kassaw, C., & Demareva, V. (2023). Determinants of academic achievement among higher education student found in low resource setting, A systematic review. *PLOS ONE*, *18*(11), e0294585. https://doi.org/10.1371/journal.pone.0294585

Konak, A., Kulturel-Konak, S., Schneider, D. R., & Mehta, K. (2024). Enhancing student learning in innovation competitions and programs. *European Journal of Engineering Education*, 1–21. https://doi.org/10.1080/03043797.2024.2394945

Kusmaryono, I., Wijayanti, D., & Maharani, H. R. (2022). Number of Response Options, Reliability, Validity, and Potential Bias in the Use of the Likert Scale Education and Social Science Research: A Literature Review. *International Journal of Educational Methodology*, *8*(4), 625–637. https://doi.org/10.12973/ijem.8.4.625

Lee, J. H., & Lee, S. (2023). Relationships between physical environments and creativity: A scoping review. *Thinking Skills and Creativity*, *48*, 101276. https://doi.org/10.1016/j.tsc.2023.101276

Ma, Y., Zhang, H., & Wang, M. (2024). The effect of parental support on student self-rated and task-based creativity: The mediating role of creative interest and self-efficacy. *Thinking Skills and Creativity*, *52*, 101512. https://doi.org/10.1016/j.tsc.2024.101512

Mebert, L., Barnes, R., Dalley, J., Gawarecki, L., Ghazi-Nezami, F., Shafer, G., Slater, J., & Yezbick, E. (2020). Fostering student engagement through a real-world, collaborative project across disciplines and institutions. *Higher Education Pedagogies*, *5*(1), 30–51. https://doi.org/10.1080/23752696.2020.1750306

Memon, M. A., T., R., Cheah, J.-H., Ting, H., Chuah, F., & Cham, T. H. (2021). PLS-SEM Statistical programs: A Review. *Journal of Applied Structural Equation Modeling*, *5*(1), i–xiv. https://doi.org/10.47263/JASEM.5(1)06

Nesbitt, K. T., Blinkoff, E., Gunersel, A. B., & Hirsh-Pasek, K. (2025). Feasibility and Acceptability of an Active Playful Learning Intervention for Kindergarten Teachers Using Instructional Coaching. *Early Education and Development*, 1–21. https://doi.org/10.1080/10409289.2025.2449688

Ozili, P. K. (2022). The Acceptable R-Square in Empirical Modelling for Social Science Research. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4128165

Palmiero, M. (2020). The relationships between abstraction and creativity. In *Creativity and the Wandering Mind* (pp. 73–90). Elsevier. https://doi.org/10.1016/B978-0-12-816400-6.00004-3

Pan, F., Zhu, G., Sui, W., & Fu, M. (2024). The effects of peer interaction on learning outcome of college students in digital environment—The chain-mediated role of attitude and self-efficacy. *Studies in Educational Evaluation*, *83*, 101404. https://doi.org/10.1016/j.stueduc.2024.101404

Quinn, D. E. (2019). The Success of First-Generation College Students in a TRIO Student Support Services Program: Application of the Theory of Margin. *Critical Questions in Education*, *10*(1).

Radović, S., Firssova, O., Hummel, H. G., & Vermeulen, M. (2023). Improving academic performance: Strengthening the relation between theory and practice through prompted reflection. *Active Learning in Higher Education*, *24*(2), 139–154. https://doi.org/10.1177/14697874211014411

Ringle, C. M., Sarstedt, M., Sinkovics, N., & Sinkovics, R. R. (2023). A perspective on using partial least squares structural equation modelling in data articles. *Data in Brief*, *48*, 109074. https://doi.org/10.1016/j.dib.2023.109074

Roberts, A. M., Sternberg, R. J., Runco, M. A., Acar, S., Ward, T. B., Kolomyts, Y., & Kaufman, J. C. (2021). Creativity and Cognition, Divergent Thinking, and Intelligence. In *Creativity* (pp. 102–127). Cambridge University Press. https://doi.org/10.1017/9781108776721.008

Rönkkö, M., & Cho, E. (2022). An Updated Guideline for Assessing Discriminant Validity. *Organizational Research Methods*, *25*(1), 6–14. https://doi.org/10.1177/1094428120968614

Rosidin, U., Herliani, D., & Viyanti. (2023). Development of Assessment Instruments in Project-Based Learning to Measure Students Scientific Literacy and Creative Thinking Skills on Work

and Energy Materials. *Jurnal Penelitian Pendidikan IPA*, *9*(6), 4484–4494. https://doi.org/10.29303/jppipa.v9i6.2421

Simek, L., & Stewart, W. H. (2024). International Student Recruitment and Support in Indonesia: A Systematic Review of Literature from 2012–2022. *Journal of Studies in International Education*, *28*(5), 818–834. https://doi.org/10.1177/10283153241235706

Singh, H. P., & Gorey, S. M. (2019). Estimation of population proportion of a qualitative character using randomized response technique in stratified random sampling. *Communications in Statistics - Theory and Methods*, *48*(4), 794–809. https://doi.org/10.1080/03610926.2017.1417436

Tan, C., Lau, X., Kung, Y., & Kailsan, R. A. (2019). Openness to Experience Enhances Creativity: The Mediating Role of Intrinsic Motivation and the Creative Process Engagement. *The Journal of Creative Behavior*, *53*(1), 109–119. https://doi.org/10.1002/jocb.170

Yang, H., & Xiang, J. (2025). Peer support and academic engagement: The moderated mediation model for college students. *Psychology in the Schools*, *62*(1), 281–295. https://doi.org/10.1002/pits.23324

Zhang, G. (2024). Innovation and Entrepreneurship Education Based on University Student Academic Competitions: Pathways, Challenges, and Strategies. *Pacific International Journal*, *7*(5), 151–156. https://doi.org/10.55014/pij.v7i5.714