



Do Free Nutritious Meal Programs and Student Well-being Improve Students' Learning Outcomes? Evidence from the Mediating Role of Learning Motivation

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Abstract: This study aims to analyze the effects of the Free Nutritious Meal Program (MBG) and student well-being on students' learning outcomes, as well as to examine the mediating role of learning motivation. A quantitative approach employing Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to analyze data collected through a structured questionnaire. The measurement model evaluation (outer model) showed that all reflective indicators satisfied the criteria for convergent validity, with outer loadings exceeding 0.70, and demonstrated adequate discriminant validity based on the Fornell–Larcker criterion. The structural model evaluation (inner model) yielded adjusted R^2 values of 0.290 for learning motivation, indicating moderate explanatory power, and 0.764 for learning outcomes, indicating substantial explanatory power. The direct effect analysis revealed that the MBG Program had positive and significant effects on both learning motivation ($\beta = 0.337$, $p < 0.05$) and learning outcomes ($\beta = 0.227$, $p < 0.05$). Likewise, student well-being positively and significantly influenced learning motivation ($\beta = 0.136$, $p < 0.05$) and learning outcomes ($\beta = 0.692$, $p < 0.05$). Mediation analysis further indicated that learning motivation significantly mediated the relationships between the MBG Program and learning outcomes, as well as between student well-being and learning outcomes. These findings suggest that nutritional support through the MBG Program and students' psychosocial well-being jointly enhance learning motivation, which subsequently contributes to improved learning outcomes.

Article History

Received: 05-10-2025

Revised: 18-11-2025

Accepted: 03-12-2025

Published: 25-12-2025

Key Words:

Free Nutritious Food;
Student Well-being;
Learning Motivation;
Learning Outcomes

How to Cite: Tamboto, H., Palangda, L., & Lempas, J. (2026). Do Free Nutritious Meal Programs and Student Well-being Improve Students' Learning Outcomes? Evidence from the Mediating Role of Learning Motivation. *Jurnal Kependidikan : Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran, Dan Pembelajaran*, 11(4), 1608-1617. <https://doi.org/10.33394/jk.v11i4.21756>



<https://doi.org/10.33394/jk.v11i3.16879>

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Introduction

Vocational education in Indonesia holds a crucial mandate in cultivating a skilled, work-ready, and adaptive young generation capable of meeting national industrial demands. One of the institutions at the forefront of this vital sector is SMK PP (Pusat Pelatihan) Kalasey, which focuses on agribusiness and food security education. The implementation of vocational education in Indonesia has increasingly emphasized competence-based education, industry relevance, and the development of graduates' employability skills to meet the demands of the labor market (Misbah et al., 2019; Misbah et al., 2020).

As a response to the challenges of meeting these biological needs, the Indonesian Government has integrated the Free Nutritious Meal (MBG) Program policy as a national strategic intervention to improve the quality of human capital from an early stage. This policy is grounded in the empirical reality that adequate nutritional intake serves as the primary fuel for optimizing students' cognitive functions and visual focus while learning in the classroom (Rif'iy Qomarrullah et al., 2025). In an agricultural vocational school environment which demands high physical endurance for field-based practicums nutritional adequacy becomes a

determining factor in whether a student can maintain concentration or, conversely, suffer from chronic fatigue that hinders academic performance (Ramdani Ratna & Gusti, 2026; Sari Adinda & Nuriza, 2024). Through routine nutritious meal interventions, schools do not merely provide caloric intake but build a solid physical foundation so that students can achieve maximum learning outcomes.

Nevertheless, meeting physical needs through nutrition is only half of the prerequisite for educational success, as the psychological dynamics of students at school play an equally fundamental role. Emotional comfort, a sense of safety, and student satisfaction with the school ecosystem collectively known as student well-being serve as key determinants in shaping healthy learning behaviors. Vocational high school (SMK) students, who face the dual pressure of academic targets and the physical workload of practical training, are highly vulnerable to academic stress if their school environment is unsupportive (Ameliana, 2024). When the school climate can foster psychological well-being, students feel valued and have a safe space to grow, which has been empirically proven to correlate positively with a surge in their academic achievements (Esti Wahyuningsih, 2025).

The relationship between external factors, such as free nutritious meals and student well-being, and learning outcomes is, in reality, not always linear or direct. There is a gap bridged by an internal psychological factor: learning motivation. From a contemporary perspective, fulfilling basic physiological needs (nutrition) and psychological needs (well-being) acts as the primary stimulator that ignites students' passion and intrinsic engagement with the learning process (Dian Camelia et al., 2025). Students who are physically well-nourished and mentally happy tend to possess a stronger drive to explore lessons, persist through practical difficulties, and exhibit high determination to achieve. Thus, learning motivation is strongly presumed to act as a mediating variable that converts the positive impacts of the free meal program and school well-being into tangible learning outcomes (Nurin Eyes & Nadia, 2025).

Although the urgency of each variable has been widely acknowledged, a profound research gap remains in the current literature. Most studies on the impact of free meals still focus on early childhood or elementary school children concerning stunting issues, and it is rarely explored in late adolescence within vocational schools particularly agricultural SMKs, which possess unique physical workload characteristics. Furthermore, few researchers have integrated physical nutritional aspects and psychological well-being into a single mediation model using learning motivation as its conceptual anchor. Herein lies the novelty of this study. By taking a specific locus at SMK PP Kalasey, this research not only evaluates the direct impact of an ongoing national strategic program but also confirms the psychological mechanism of how learning motivation mediates the influence of students' physical and mental aspects in determining academic success in vocational schools.

Research Method

This study uses a quantitative approach with a causal-associative design that aims to test and analyze the causal relationships between variables and the role of mediators within them (Creswell & Creswell, 2023). This design was chosen to empirically demonstrate whether the Free Nutritional Meal Program (X_1) and Student Well-being (X_2) influence Student Learning Outcomes (Y), both directly and indirectly through Learning Motivation (M) as a mediating variable. Using a statistical approach, this study will isolate the influence of each variable to examine the linear relationship structure formed in the path analysis model.



The population in this study includes all active students at the State Vocational High School for Agricultural Development (SMKN PP) Kalasey, Mandolang District, Minahasa Regency, North Sulawesi Province, enrolled in the 2025/2026 academic year. The focus population was specifically limited to the Agribusiness and Agritechology (agriculture major) cluster or area of expertise, which includes the Crop Agribusiness, Livestock Agribusiness, Integrated Agricultural Enterprises, and Agricultural Product Processing Agritechology Expertise Programs. This population limitation was based on the characteristics of agricultural vocational students who require optimal physical energy for field practice activities (teaching factory), making them relevant targets for the Free Nutritious Meals pilot program. Given the specific population size, sampling was conducted using probability sampling techniques using stratified random sampling based on the expertise program and grade level (10, 11, and 12). This step was taken to ensure a balanced representation between students who are dominated by theory in class and students who actively engage in practical work on the school's agricultural land. The minimum sample size was determined by referring to the provisions of structural path modeling, which ranges from five to ten times the number of observed variable indicators (Hair et al., 2024). Therefore, the target sample was all or most of the students from the comparison vocational study group who met the study's inclusion criteria. The operationalization of variables in this study was designed to describe each theoretical concept into indicators relevant to the agricultural vocational education ecosystem at SMKN PP Kalasey.

The Free Nutritious Food Program variable (X_1) was measured through vocational students' perceptions of taste quality, adequacy of energy portions for field practice activities, macronutrient content, and consistency of food distribution at school, by adapting instruments from UNESCO (2023) and Sukamto et al. (2024). The Student Well-being variable (X_2) was operationalized through indicators of student satisfaction with the learning environment (including the comfort of the dormitory and practice area), positive social relationships with productive teachers and fellow students, and the level of physical endurance and energy vitality of students when following practical instructions (Huebner et al., 2025; OECD, 2024). Furthermore, the Learning Motivation variable (M) was measured using indicators of student persistence in completing complex agribusiness tasks, a desire to master modern agricultural expertise competencies, and a deep interest in agricultural curriculum materials (Schunk & Mullen, 2025). These three variables were measured using primary data in the form of a closed-ended questionnaire with a Likert scale of 1–5. Meanwhile, the Learning Outcomes (Y) variable was operationalized as students' objective academic and practical competency achievements, measured using secondary data in the form of final semester exam recapitulation scores and skill competency evaluation scores (practical) sourced directly from the official SMKN PP Kalasey curriculum document (Kemendikbudristek, 2025).

The data collection process was conducted through two main channels: primary data dissemination and secondary data collection. Primary data collection was conducted by distributing questionnaires directly to students, accompanied by class teachers or researchers to ensure understanding of the questions. Secondary data, in the form of report card scores and practical scores, were obtained through a documentation study conducted by the school administration department after obtaining official permission. Before the questionnaire instrument was used in full-scale data collection, a pilot study was conducted on 30 students outside the main sample to test the instrument's validity and reliability. The validity test uses the Corrected Item-Total Correlation technique with the criteria of $r_{\text{calculated}}$ value $> r_{\text{table}}$ or Loading Factor > 0.60 , while the reliability test is assessed based on the Cronbach's

Alpha coefficient or Composite Reliability which must exceed the threshold of 0.70 for the instrument to be declared reliable (Sekaran & Bougie, 2016).

The final data analysis in this study applied inferential statistics with the help of SPSS or SmartPLS software. Before testing the hypothesis, the data was first ensured to meet the classical assumptions which include residual normality test, multicollinearity test, and heteroscedasticity test so that the resulting regression model is unbiased (Best Linear Unbiased Estimator). Hypothesis testing was conducted using path analysis with two structural equations. The first equation places Learning Motivation (M) as the dependent variable influenced by Free Nutritious Meals (X1) and Student Welfare (X2) with the formula $M = \beta_1 X_1 + \beta_2 X_2 + e_1$. The second equation tests the effect of Free Nutritious Meals (X1), Student Welfare (X2), and Learning Motivation (M) together on Learning Outcomes (Y) through the formula $Y = \beta_3 X_1 + \beta_4 X_2 + \beta_5 M + e_2$. To statistically demonstrate the significance of the mediating role of learning motivation, this study employed the bootstrapping method or the Variance Accounted For (VAF) approach. The mediation effect was declared significant if the p-value of the indirect effect was less than 0.05, indicating that learning motivation significantly mediated the impact of the student nutrition and well-being program on improving their academic and practical learning outcomes (Hair et al., 2024).

Results and Discussion

To assess whether the measurement model of a reflective construct meets the requirements for convergent validity, two primary criteria must be fulfilled: (1) the indicator loading value (outer loading) must be greater than 0.70, and (2) the p-value must be significant ($p < 0.05$). However, in practice particularly with newly developed instruments or questionnaires loading values above 0.70 are not always achieved in the initial analysis. Consequently, indicators with loading values between 0.40 and 0.70 can still be considered for retention. Indicators with values below 0.40 must be removed from the model because they are deemed inadequate of representing the latent construct. Meanwhile, for indicators within the 0.40 to 0.70 range, further analysis is required to observe their impact on the Average Variance Extracted (AVE) and Composite Reliability (CR). The deletion of indicators within this range may be executed if it is proven to increase the AVE value above the minimum threshold of 0.50 and the CR above 0.70. Nevertheless, deletion decisions must also take content validity into account, as in some cases, indicators with low loadings are retained if they provide a highly critical conceptual contribution to the construct.

Table 1. Validity Testing Based on Outer Loading

Indicator	Free Nutritious Food	Student Welfare	motivation to learn	Learning outcomes
MBG1	0.780			
MBG2	0.740			
MBG3	0.863			
KS1		0.762		
KS2		0.775		
KS3		0.823		
MOT1			0.899	
MOT2			0.788	
MOT3			0.874	
HB1				0.773
HB2				0.890
HB3				0.976
HB4				0.791
HB5				0.864

Based on Table 1, it is evident that all measurement items for all variables exhibit loading factor values greater than 0.70. Consequently, it can be concluded that all measurement items in this study have successfully met the convergent validity criteria to an excellent degree. Subsequently, the evaluation proceeds by testing discriminant validity using the Average Variance Extracted (AVE) values, alongside reliability testing using Composite Reliability (CR) and Cronbach's Alpha (CA).

Discriminant Validity Testing

Composite Reliability (CR) is utilized in the PLS-SEM method to assess the overall reliability of a construct by considering the specific weights of each indicator on its respective latent variable. Meanwhile, Cronbach's Alpha measures the internal consistency of the instrument based on the inter-item correlations within a single variable. A higher alpha value indicates greater consistency among the items within the measurement instrument. The discriminant validity testing using the Fornell-Larcker Criterion is presented in Table 2.

Table 2. Discriminant Validity Testing: Fornell-Larcker Criterion

Variable	Free Nutritious Food	Student Welfare	motivation to learn	Learning outcomes
Free Nutritious Food	0.713			
Student Welfare	0.475	0.645		
motivation to learn	0.569	0.517	0.653	
Learning outcomes	0.441	0.536	0.412	0.595

Note: Values on the main diagonal (in bold) are the square root of the AVE.

Based on Table 2 above, the square root value of the AVE for each variable is greater than the correlation value between that construct and any other constructs. Therefore, it can be concluded that all variables in this study have successfully met the criteria for discriminant validity.

Structural Model Evaluation (Inner Model)

R-Square (R^2) Value

In Structural Equation Modeling (SEM), structural models are used to test causal relationships among latent variables. One important measure in evaluating a structural model is the R-Square (R^2), which indicates the extent to which the independent variables explain the variance of the dependent variable.

Table 3. R-Square and Adjusted R-Square Values

Variable Dependent	R-Square	R-Square Adjusted
Motivation to learn	0.539	0.290
Learning outcomes	0.874	0.764

Based on Table 3, the results of the R-square analysis are outlined as follows:

- 1) Learning Motivation: The adjusted R-square value for the Learning Motivation variable is 0.290. This indicates that the implementation of the Free Nutritious Meal Program and Student Welfare together explain 29% of the variance in Learning Motivation, categorizing this model as moderate.
- 2) Learning Outcomes: The adjusted R-square value for the Student Learning Outcomes variable is 0.764. This indicates that the Free Nutritious Meal Program, Student Welfare, and Learning Motivation simultaneously explain 76.4% of the variance in Student Learning Outcomes. This high contribution places the model in the very strong category.

Effect Size (f^2)

Effect size (f^2) in PLS-SEM is used to assess the contribution or strength of influence of an independent variable on a specific dependent variable in a structural model.

Table 4. Effect Size (f^2)

Variable Independent	Motivation to learn	Learning outcomes
Free Nutritious Food	0.256	0.385
Student Welfare	0.189	0.261
Motivation to learn	-	0.561

The explanation of the effect size values in Table 4 is as follows:

- 1) The effect of the Free Nutritious Meal Program on Learning Motivation is 0.256, categorizing the effect as moderate.
- 2) The effect of Student Well-Being on Learning Motivation is 0.189, categorizing the effect as moderate.
- 3) The effect of the Free Nutritious Meal Program on Student Learning Outcomes is 0.385, categorizing the direct effect as strong.
- 4) The effect of Student Well-Being on Student Learning Outcomes is 0.261, categorizing the direct effect as moderate.
- 5) The effect of Learning Motivation on Student Learning Outcomes is 0.561, categorizing the effect as very strong.

Hypothesis Testing and Significance of Effects

Hypothesis testing was conducted by examining the Path Coefficient, t-statistics, and p-values. The hypothesis is accepted if the t-statistic is >1.66 and the p-value is <0.05 .

Table 5. Results of Path Coefficient Test & Significance of Influence

Path Relationship	Path Coefficient	t-statistics	P-values	Conclusion
Free Nutritious Meals → Learning Motivation	0.337	3.267	0.001	Hypothesis Accepted
Free Nutritious Meals → Learning Outcomes	0.227	2.024	0.001	Hypothesis Accepted
Student Well-being → Learning Motivation	0.136	6.560	0.019	Hypothesis Accepted
Student Well-being → Learning Outcomes	0.692	3.712	0.007	Hypothesis Accepted
Learning Motivation → Learning Outcomes	0.676	5.006	0.000	Hypothesis Accepted
Free Nutritious Meals → Learning Motivation → Learning Outcomes	0.227	3.294	0.001	Hypothesis Accepted
Student Well-being → Learning Motivation → Learning Outcomes	0.392	2.712	0.007	Hypothesis Accepted

Based on the test results in Table 5, the following path analysis findings were obtained:

- 1) Free Nutritious Meals → Learning Motivation: The Free Nutritious Meals Program has a positive and significant effect on learning motivation with a coefficient of 0.337, $t=3.267>1.66$, and $p=0.001<0.05$ (Hypothesis Accepted).
- 2) Free Nutritious Meals → Learning Outcomes: The Free Nutritious Meals Program has a direct positive and significant effect on student learning outcomes with a coefficient of 0.227, $t=2.024>1.66$, and $p=0.001<0.05$ (Hypothesis Accepted).
- 3) Student Well-Being → Learning Motivation: Student well-being has a positive and significant effect on learning motivation with a coefficient of 0.136, $t=6.560>1.66$, and $p=0.019<0.05$ (Hypothesis Accepted).

- 4) Student Well-Being → Learning Outcomes: Student well-being has a direct positive and significant effect on student learning outcomes, with a coefficient of 0.692, $t=3.712>1.66$, and $p=0.007<0.05$ (Hypothesis Accepted).
- 5) Learning Motivation → Learning Outcomes: Learning motivation has a direct positive and significant effect on student learning outcomes, with a coefficient of 0.676, $t=5.006>1.66$, and $p=0.000<0.05$ (Hypothesis Accepted).
- 6) Free Nutritious Meals → Learning Motivation → Learning Outcomes (Mediation): The Free Nutritious Meals Program has a positive and significant effect on student learning outcomes through the mediation of learning motivation, with an indirect effect coefficient of 0.227, $t=3.294>1.66$, and $p=0.001<0.05$ (Hypothesis Accepted).
- 7) Student Welfare → Learning Motivation → Learning Outcomes (Mediation): Student Welfare has a positive and significant effect on student learning outcomes through the mediation of learning motivation, with an indirect effect coefficient value of 0.392, $t=2.712>1.66$, and $p=0.007<0.05$ (Hypothesis Accepted).

The successful improvement of student learning outcomes in this study cannot be decoupled from the positive contribution of the Free Nutritious Meal (MBG) Program, which is empirically proven to enhance both student motivation and academic achievement. This finding reinforces Abraham Maslow's Hierarchy of Needs, which posits that physiological needs including nutritional adequacy form the most foundational layer that must be satisfied before individuals can achieve self-actualization and reach their highest cognitive potential. Biologically and cognitively, healthy dietary intake at school works to stabilize students' physical metabolism, prolong attention spans, and sharpen concentration during the learning process. This aligns with prior research by Sukamto et al. (2024) and reports by UNESCO (2023), which affirm that school-based nutritional interventions effectively eliminate physical barriers such as hunger and fatigue, thereby stimulating intellectual curiosity and enhancing students' capacity to absorb complex instructional materials.

Beyond nutritional aspects, the comfort of the psychosocial environment as reflected by Student Well-being also plays a vital role in determining academic success. Well-being, which encompasses emotional stability, secure social relationships with teachers and peers, and physical health at school, is proven to be an absolute prerequisite for students to learn productively. This phenomenon supports Urie Bronfenbrenner's Ecological Systems Theory, wherein a positive and supportive school microsystem minimizes student stress and academic anxiety. The results of this study are consistent with research by Huebner et al. (2025) and global reports by the OECD (2024), which state that when students' emotional states are happy and protected from bullying, their mental infrastructure operates at optimal capacity, allowing their cognitive reasoning and memory to function exceptionally well during learning evaluations.

Furthermore, this study successfully uncovers the deep psychological mechanism through which physical interventions (free meals) and environmental interventions (well-being) are transformed into tangible academic achievements via the mediating role of Learning Motivation. Grounded in Self-Determination Theory developed by Deci and Ryan, external and environmental factors do not instantaneously alter student behavior or learning capabilities; rather, they must first be internalized into intrinsic motivation within the individual. The presence of the free nutritious meal program provides the necessary physical energy supply, while a sense of well-being at school offers emotional stability and safety. This dynamic combination is what awakens self-confidence, persistence, and a strong desire within students to master subject-matter competencies.



This optimally stimulated learning motivation subsequently manifests as consistent changes in daily learning behaviors. Referencing contemporary motivation theory by Schunk and Mullen (2013), students with strong internal drives exhibit higher levels of discipline, active participation in discussions, and deep focus when listening to classroom instructions. These positive behaviors, propelled by motivation, serve as the primary engine driving higher examination scores and learning evaluation achievements. This finding is also supported by prior empirical research stating that motivation acts as the most potent psychological predictor of academic success in formal educational institutions.

Comprehensively, the structural model in this study demonstrates a pattern of partial mediation, meaning that student learning outcomes can be directly enhanced through nutritional fulfillment and the reinforcement of well-being, yet the impact is greatly multiplied if students' internal motivation is successfully activated by both initiatives. An integrative policy that merges healthy physical intake with the cultivation of a joyful school climate is proven to be the most effective strategy for building an excellent educational ecosystem. This conclusion reinforces the policy direction of the *Kurikulum Merdeka* (Kemendikbudristek, 2021), which consistently emphasizes the importance of holistic character development, mental well-being, and student learning readiness to yield sustainable academic competency outcomes.

Conclusion

This study concludes that the Free Nutritious Meal (MBG) Program and Student Well-being constitute foundational pillars critical to substantially enhancing student learning outcomes. Fulfilling basic nutritional requisites within educational institutions transcends mere social welfare; rather, it represents a strategic cognitive investment that directly mitigates somatic barriers such as hunger and chronic fatigue. When this optimal physiological state is coupled with a secure, supportive, and conducive school climate, it significantly lowers academic anxiety while maximizing cognitive capacity, memory retention, and critical reasoning.

Furthermore, this research substantiates the mechanism of Learning Motivation as an indispensable psychological conduit (mediating variable). Structural interventions via nutritional provisioning and psychosocial well-being do not yield immediate, linear shifts in academic performance; instead, they operate by systematically catalyzing and nurturing students' intrinsic behavioral drives. Sustained nutritional intake guarantees physical vitality, whereas elevated student well-being fosters emotional equilibrium. This synergistic dynamic cultivates academic self-efficacy, persistence, and a strong achievement orientation, which sequentially translates into heightened classroom discipline and focused cognitive engagement, ultimately culminating in exponentially higher learning outcomes.

Recommendation

Based on the findings, it is recommended that policymakers sustain and strengthen the Free Nutritious Meal (MBG) Program as a long-term educational investment by ensuring the consistent provision of nutritionally balanced meals. Schools should also foster a safe, inclusive, and supportive learning environment to enhance student well-being and create conditions conducive to learning. Furthermore, educators should implement instructional strategies that strengthen students' learning motivation, as motivation serves as a key mechanism linking nutritional support and student well-being to improved learning outcomes. Future research is encouraged to employ longitudinal or experimental designs and



examine additional mediating or moderating variables to further explain the relationship between the MBG Program, student well-being, learning motivation, and learning outcomes.

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