How Do the Cognitive and Affective Self-Concepts Influence the Academic Performance of Vocational Students?

Jaka Wijaya Kusuma[1]*, Hamidah [2]

[1]Department of Mathematics Education, Universitas Bina Bangsa, Serang, Indonesia

[2]Department of Mathematics Education, Universitas Bina Bangsa, Serang, Indonesia

*Corresponding Author: jakawijayak@binabangsa.ac.id,

ABSTRACT

This study examines the effect of cognitive and affective academic self-concept on the academic performance of vocational high school students based on data obtained from the findings. Pearson correlation analysis was conducted on 127 observations, revealing statistically significant correlations between the measured variables. A linear regression model was developed to forecast the dependent variable using the independent variables X1 and X2, showing that the independent variables could explain approximately 49.1% of the dependent variable's variability. Analysis of variance (ANOVA) supported the efficacy of this model with a significant F value of 58.057. In addition, the scale used in this study showed satisfactory internal consistency with a Cronbach's Alpha coefficient of .708. No signs of multicollinearity were found, indicating that the model is robust and reliable. Overall, the findings of this study provide evidence that cognitive and affective academic self-concepts have a significant role in vocational education and positively impact students' academic performance. These results also set a solid foundation for further research and developing interventions to improve students' academic performance in vocational secondary schools.

INTRODUCTION

Vocational education and training (VET) has become an important area of study over the past two decades because of its strategic role in bridging the gap between the world of education and the world of work. Several studies have shown that VET allows learners to experience the link between learning and real working life directly (Boersma et al., 2010; Green et al., 2009; Hartog et al., 2022; Mndebele & Dlamini, 2008). It is the relationship that not only increases the relevance of learning but also fosters motivation to choose a career path, especially when the chosen field of expertise is aligned with the individual's personal development and well-being (Takyi Mensah et al., 2023). Vocational education also serves as a means of developing specific work skills that can be directly applied in the world of work, thus strengthening the work readiness of graduates (Ogbunaya & Udoudo, 2015).

In addition to providing employability skills, vocational education and training can be a basis for further education to a higher level in a particular field, opening up opportunities for personal and professional growth. In the context of developing countries, the transition from school to work is a key youth policy issue (Mufune, 1999). This transition process has received considerable attention in academic research, particularly in understanding how individuals transition from adolescence to adulthood and form self-identities in different social and economic contexts (Ferm et al., 2018). Thus, vocational education is

practically relevant and significantly contributes to career formation and identity development in contemporary society.

Mathematics is widely acknowledged as a fundamental and indispensable discipline in tackling significant issues in science, technology, and society. Moreover, it is important as a vital constituent of any vocational program (Anastasakis et al., 2022). Competencies in mathematics have a pivotal role in shaping students' educational experience and significantly impact their prospects for achievement in the professional realm. (Norris, 2023). Nevertheless, the precise operational process by which knowledge is reconstructed through learning in the context of practical activities in vocational education remains unclear (Van Schaik et al., 2010). Modifying teacher practices from conventional to scientific approaches involves shifting to student-centred and active learning habits. (Nurtanto et al., 2021). Thus far, there has been a lack of significant impact on enhancements in learning outcomes. Have limited past mathematics achievement and tend to lack interest (Dalby & Noyes, 2016), and critical and innovative problem-solving capacities are severely constrained (Mutohhari et al., 2021). Students often encounter numerous difficulties that can be classified into three distinct categories: epistemological and cognitive issues, sociological and cultural obstacles, and didactical difficulties (De Guzmán et al., 1998).

Consequently, mathematics is a subject that is often associated with dissatisfaction (Nardi & Steward, 2003). Hence, it is imperative to enhance the quality of mathematics instruction and competence while addressing the difficulties inherent in identifying and implementing enhancements. It is particularly crucial in comprehending the distinctive characteristics of vocational students. The significance of self-concept lies in its potential to shape an individual's behaviour through the influence of their self-perceptions (Kahraman et al., 2022). Academic self-concept refers to the cognitive representation of an individual's academic talents, encompassing their overall academic aptitude and proficiency in various academic disciplines (Brunner et al., 2010). It can motivate students to aspire to a career and attain academic achievement (Seaton et al., 2010; Suárez-Álvarez et al., 2014). For students pursuing vocational education, self-concept encompasses an individual's impression of their abilities and proficiency across several tasks, enabling them to predict their future accomplishments and particular occupational choices (Eccles & Wigfield, 2020).

Within education, it is possible to distinguish a student's self-concept into two distinct components: cognitive and affective (Arens et al., 2011). The cognitive component pertains primarily to an individual's perceived competence or proficiency level. On the other hand, the affective component refers to the emotional and motivational reaction an individual experiences towards a particular topic, reflecting their preference or liking. Self-concept is the comprehensive collection of all thoughts, impressions, and feelings individuals possess about themselves as objects. In other words, it constitutes the arrangement of attributes that individuals ascribe to themselves (Hammoudi, 2020). Students with strong confidence in their academic prowess, sometimes called high academic self-concepts, tend to exhibit greater motivation and get higher grades (Guo et al., 2017). Therefore, more participatory and developmentally appropriate approaches, such as the use of visual methods and the inclusion of children's self-reports, are needed to provide a more accurate and meaningful understanding of well-being.

Moreover, it is crucial to note that domain-specific academic self-concepts significantly impact educational choices, specifically on the choice of a course (Nagy et al., 2006). This study aims to examine the influence of cognitive and affective components of self-concept on students' academic performance. It aims to identify and analyze how individuals' perceptions of competence (the cognitive component) and their emotional and motivational responses to certain topics (the affective component) relate to their academic performance. The results of this study are expected to provide a deeper understanding of the factors that contribute to student success in education.

METHODS

This study is classified as quantitative research due to its utilization of a research methodology that encompasses research proposals, procedures, hypothesis formulation, fieldwork implementation, data analysis, drawing conclusions based on data, and presenting findings employing elements of measurement, calculations, formulae, and reliance on numerical data for certainty (Fraenkel et al., 2011). Multiple regression is a statistical technique to analyze the relationship between a single dependent and several independent variables (Chen & Tsurumi, 2010; Wagner et al., 2011). The objective of multiple regression analysis is to use the independent variables whose values are known to predict the value of the single dependent value. The procedure is described below:
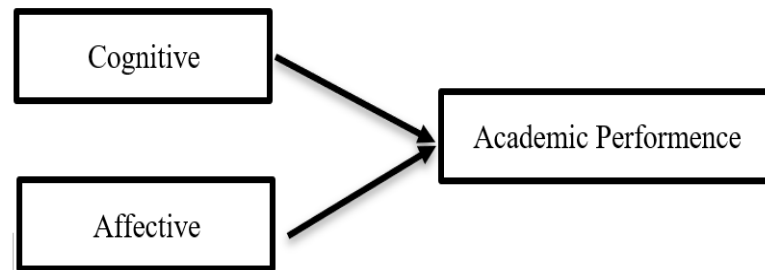

Figure 1. The Multiple regression

The present study was conducted in the West Java Province during the academic year 2023/2024, specifically from August to October 2024. The target population for this research consisted of all students enrolled in the State Vocational High School specializing in Software Engineering located in the Majalengka district. The total number of students included in the study was 182. The employed sampling technique is purposive sampling, which was utilized to acquire a representative sample of pupils who had engaged in daily maths assessments focusing on inequality concepts. The material selection was based on its significance as a fundamental subject matter in which students are expected to acquire proficiency. Inequality is essential in mathematics due to its interconnectedness with other fundamental concepts, including equations and functions (Moon, 2020). A total of 127 students were selected as research sampling.

The research results were acquired using several test instruments, encompassing cognitive and affective self-concept scale tests and writing skill exams featuring content related to inequality. The assessment of the instrument's validity and reliability necessitates examining expert opinions and the conduct of trials in educational settings beyond the specific class being investigated. Upon completing these procedures, it will be ascertained if all instruments devised by the researchers have satisfied the criteria for validity and reliability. The validity coefficient for each test item demonstrates a high level of 0.72, indicating a strong relationship between the test items and the measured construct. Additionally, the reliability coefficient of 0.83 indicates high consistency and stability in the test scores. Moreover, the utilization of multiple regression analysis enables the determination of the impact of the independent variable on the dependent variable, leading to a conclusive inference.

RESULTS AND DISCUSSION

Result

This study examines the impact of cognitive and affective academic self-concept on the academic performance of vocational high school students based on the data acquired from the findings. The forthcoming justification presents the hypothesis that will be employed to substantiate the assertion that there is an influence between cognitive and affective academic self-concept and students' academic performance in vocational high schools. Before working on a multiple regression analysis, it is necessary to assess the data using Pearson's correlation to ascertain the suitability of the instrument measurement. Table 1 is described below:

Table 1. Pearson Correlation

		X1	X2	Y
X1	Pearson Correlation	1	.659**	.304**
	Sig. (2-tailed)		.000	.000
	N	127	127	127
X2	Pearson Correlation	.435**	1	.304**
	Sig. (2-tailed)	.000		.001
	N	127	127	127
Y	Pearson Correlation	.435**	.639**	1
	Sig. (2-tailed)	.000	.000	
	N	127	127	127

A Pearson correlation analysis was conducted on a sample of 127 observations, which unveiled multiple statistically significant correlations. The correlation coefficient between X1 and X2 was 659 (p < 0.001), suggesting a robust and favourable association between these two variables. Similarly, the variables X1 and Y exhibited a moderate positive association, as evidenced by a correlation coefficient of .304 (p < 0.001). The relationship between X2 and Y exhibited a positive and moderate connection, as evidenced by a correlation coefficient of .304 (p = 0.001). Furthermore, it was shown that the Y variable had a moderate positive correlation with X1 (r = .435, p < 0.001) and a strong positive association with X2 (r = .639, p < 0.001). The obtained results provide evidence for a substantial linear association between the variables, suggesting the need for additional investigation using multivariate analysis methods, specifically multiple regression analysis. A reliability test is also employed to enhance the data's suitability for subsequent testing, as indicated by the findings presented in Table 2.

Table 2. Reliability Statistics

Cronbach's Alpha	N of Items
.708	3

The scale demonstrated satisfactory internal consistency, as indicated by a Cronbach's Alpha coefficient of .708 for the three items. The indicated number reflects satisfactory reliability, implying that the items within the scale exhibit modest correlations and effectively assess a unified concept. Additionally, a multiple regression analysis was performed, yielding the following outcomes.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.705ᵃ	.491	.485	2243406

a. Predictors: (Constant), X2, X1
b. Dependent Variable: Y

The linear regression model was constructed to forecast the dependent variable Y using independent variables X1 and X2. The resulting correlation coefficient R was found to be .705. This finding suggests a robust linear correlation between the dependent and independent variables. The model's coefficient of determination (R Square) is calculated to be .491, indicating that about 49.1% of the variability seen in the dependent variable Y can be accounted for by the independent variables X1 and X2. Upon accounting for the number of predictors, the Adjusted R Square value is.485, signifying that the model can account for about 48.5% of the variability in the dependent variable Y. The standard error of the estimate, 2243406, quantifies the discrepancy between the actual value and the predicted value generated by the model. This metric serves

as an indicator of the model's predictive precision. The model offers valuable insights into the correlation between X1, X2, and Y, demonstrating satisfactory conformity with the data.

Table 4. ANOVA[a]

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.763	2	2.889	58.057	.000[b]
	Residual	5.934	124	.045		
	Total	11.712	126			

a. Dependent Variable: Y
b. Predictors: (Constant), X2, X1

The application of analysis of variance (ANOVA) to the regression model that predicts the dependent variable Y using the predictors X1 and X2 yielded significant findings. In the context of regression analysis, the model under consideration accounted for a total variance of 5,763. This value was obtained using 2 degrees of freedom, which aligns with the number of predictors utilized in the model. The average amount of variation accounted for by each predictor is 2.889. Additionally, the statistically significant F value of 58.057 suggests that the model possesses substantial predictive capability. The obtained p-value of .000 provides strong evidence to support the statistical significance of the model in accurately predicting the dependent variable, with a significance level of .05. The residual, which represents the remaining variance not accounted for by the model, has a value of 5.934. This residual is associated with 124 degrees of freedom. The average unexplained variation, or mean residual, is also calculated as 0.045. The overall variability seen in the dataset amounts to 11,712 units, as determined by the analysis conducted with 126 degrees of freedom. In general, the ANOVA findings support the efficacy of this regression model in elucidating the variability observed in the dependent variable, Y. The model accounts for roughly 49.1% of the observed variance, signifying substantial predictive capability and a favourable alignment with the data.

Table 5. Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	.478	.345		1.389	.170					
X1	.219	.060	.250	3.629	.000	.321	.236	.126	.920	1.098
X2	.670	.080	.586	8.500	.000	.621	.558	-.009	.920	1.098

a. Dependent Variable: Y

The regression analysis was performed to forecast the dependent variable Y using independent variables X1 and X2. As indicated by a Sig, the results revealed a significant finding for both variables. Value of .000. This suggests that X1 and X2 substantially impact predicting Y at the conventional confidence level (α = 0.05). Moreover, the assessment of multicollinearity using the Variance Inflation Factor (VIF) revealed a value of 1.098 for both variables, which falls far below the widely accepted threshold of 5 or 10. This outcome substantiates the absence of substantial indications of multicollinearity among the independent variables. The findings suggest that the model employed in this study is both robust and valid in its analytical approach. The independent variables demonstrate a notable impact on the dependent variable, while the absence of collinearity concerns ensures the accurate interpretation of the coefficients.

The present study examined the impact of cognitive academic self-concept (X1) and affective academic self-concept (X2) on academic performance (Y) within the context of vocational secondary schools. The results revealed a statistically significant and positive association between both dimensions of self-concept

and academic performance. The cognitive academic self-concept pertains to students' subjective evaluations of their talents within the academic sphere, while the affective self-concept encompasses their emotional experiences and attitudes toward themselves in the academic environment. These self-concepts have been found to impact students' academic performance favorably. The regression model demonstrated a capacity to account for around 49.1% of the variability observed in academic performance. Furthermore, there were no signs of multicollinearity, suggesting that the model is robust and reliable. The scale utilized in this investigation exhibited satisfactory levels of internal consistency. In general, the findings of this study give evidence that cognitive and affective self-concept plays a significant role in vocational education. These results also lay a solid foundation for future research and the creation of treatments that enhance students' academic performance.

Discussion

Several reports have shown that numerous studies have investigated the associations between academic achievement and self-concept. (Arens et al., 2021; Erten & Burden, 2014; Guay et al., 2003; Marsh & Craven, 1996; Marsh & Martin, 2011; Wu et al., 2021). Rather than being a singular entity, self-concept is understood as a complex construct encompassing various aspects, including academic, social, and emotional self-concepts (Marsh & Hattie, 1996). The study reveals that academic self-concept is comprised of two distinct components that have a simultaneous impact on students' academic performance. It refers to what has been expressed by (Arens et al., 2016) Suggests the division of variables into two distinct components: cognitive and affective, which are associated with a domain-specific academic self-concept, such as math cognitive self-concept and math affective self-concept. Research has indicated a stronger influence between the cognitive component and academic performance (Arens et al., 2011; Marsh et al., 2013).

In contrast, the affect component appears to have a stronger correlation with behavioral markers, including those related to allocating effort (Pinxten et al., 2014). The multifaceted nature of self-concept is highlighted, dividing it into cognitive and affective components, each with distinct impacts on academic performance and behavior. While the cognitive aspect strongly correlates with academic performance, the affective component seems more linked with behavioral aspects, such as effort allocation.

The present study was designed to determine the effect of cognitive and affective on academic performance. Self-concept, commonly understood as an individual's subjective understanding of academic abilities or skills, is widely acknowledged as a significant determinant of human learning. Personal experiences and interpreting the educational context shape this view (Marsh & Martin, 2011). The significance attributed to the improvement of self-concept is typically grounded in the assumption that a heightened self-concept will result in emotions of self-worth and self-acceptance (Marsh & Craven, 1996). The study underscores the integral role of self-concept, particularly the cognitive and affective components, in influencing academic performance. The nurturing of self-concept fosters academic growth and enhances feelings of self-worth and self-acceptance. In substance, creative work builds the capacity of one to transcend itself.

The results of this study offer compelling evidence supporting the existence of a substantial relationship between cognitive and affective self-concept and the academic achievement of students enrolled in vocational high schools. The model employed in this work demonstrates apparent validity and robustness, as evidenced by the consistent outcomes across several statistical methodologies. The analysis thoroughly examines the primary discoveries and the research approach employed in the study, demonstrating the intricate connection between the cognitive and affective aspects of academic self-concept and students' academic achievement.

The investigation findings indicate that cognitive and affective factors simultaneously impact student performance. Nevertheless, it is important to note that no discernible influence or correlation exists between

cognitive and affective academic self-concepts. A comparison of the findings with those of other studies confirms (Karimova & Csapó, 2021) further substantiating the differentiation of self-concept facets, particularly within the linguistic domain of self-concept. This study further strengthens the argument that these two dimensions, cognitive and affective, should be recognized as distinct entities. These results seem consistent with other research, which found (Marsh & Hau, 2004) that the study's findings on math and verbal self-concepts were not significantly correlated.

Furthermore, it was observed that math achievement had a positive impact on math self-concept but a negative impact on verbal self-concept. Conversely, verbal achievement positively impacted verbal self-concept but harmed math self-concept. The analysis suggests that self-concept in mathematics and verbal domains are distinct facets of self-concept, specifically cognitive and affective components. Mathematics is frequently linked to the cognitive domain, whereas verbal skills are related to the affective domain, implying that both domains are distinct entities and exert diverse impacts on students' academic achievement.

One plausible explanation for this phenomenon could be the prevailing consensus surrounding these concepts. By examining this consensus, it becomes feasible to discern several probable factors that may explain their lack of correlation. The observed variations may be indicative of the disparities in the domain. Cognitive refers to perceived usefulness, which pertains to the students' subjective perception of the significance of a discipline (mathematics) in their daily lives and future endeavours (Adelson & McCoach, 2011). Its usefulness is a positive predictor of success (Guy et al., 2015). Thus, this phenomenon may be explained through the existing consensus regarding these concepts, where observed variations indicate differences in domains. Cognitive aspects and students' perceptions of the usefulness of the discipline (such as mathematics) in their daily lives and future endeavours are potentially determining factors in their success.

On the other hand, domain effectiveness refers to attitude and can be defined as an individual's acquired inclination to react favorably or unfavourably towards an entity, circumstance, abstract notion, or individual. (Mazana et al., 2019). The strategies and procedures employed to enhance cognitive components may vary from those employed for affective elements, and the outcomes of one form of intervention may not directly correlate with another (Cutuli, 2014). The methodologies and procedures employed to enhance these elements may exhibit variations, and the outcomes of one form of intervention may not directly correlate with the other. It highlights the necessity of employing distinct and tailored methodologies for teaching and evaluating these two dimensions within a classroom environment.

Hence, it is imperative to strategise educational approaches that may effectively enhance students' academic achievements while considering their cognitive and affective self-perception. The didactic learning method, particularly in mathematics education, is recognized as one of the instructional approaches that can effectively support pupils in multiple dimensions. The didactic method pertains to students' diffusion and knowledge acquisition (Chevallard, 2015). It has three main Pillars: Vergnaud's theory of conceptual fields (Vergnaud, 1992). The theory of didactical situations (Brousseau, 2006; Chevallard, 2019), and the anthropological theory of the didactic (ATD) that emerged from Chevallard's theory of didactic transposition (Chevallard & Sensevy, 2014). The three pillars of the didactic approach to learning mathematics are interconnected and adapted to the institution where the students are. Firstly, the mathematics material is presented as a relevant discipline. Secondly, situations assist students in performing mental actions and developing ways of thinking and understanding (Harel, 2008). Finally, the concept of 'conceptual field' is integrated to account for students' affective aspects, making this approach more holistic.

The findings reported here suggest that cognitive and affective academic self-concept exert a notable positive impact on the academic performance of vocational high school students. Both variables demonstrated statistically significant correlations with academic performance, with cognitive academic self-concept relating to students' subjective evaluation of their academic talents and affective academic self-concept encompassing their emotional experiences and attitudes within the academic setting. The Pearson

correlation and multiple regression analyses have shown robust and favourable associations between these variables, while the absence of substantial multicollinearity indicates the model's reliability. Additionally, the satisfactory internal consistency of the scale further supports the validity of the findings. This evidence highlights the importance of cognitive and affective self-concept in understanding and enhancing academic success in vocational education, accounting for around 49.1% of the variability in academic performance.

These findings imply that understanding and developing cognitive and affective academic self-concept may effectively improve students' academic achievement in vocational schools. It suggests that education and interventions designed to strengthen these aspects may have a significant impact on helping students succeed in their educational goals. In addition, the absence of strong indications of multicollinearity in the model suggests that each variable has a unique role in explaining academic achievement, thus adding insight and opportunity for more focused and specific interventions. As such, these findings pave the way for more integrated and holistic educational strategies that recognise and prioritise the role of self-concept in vocational education, potentially guiding future educational research and practice.

Additional research is needed to understand better the nuanced interplay between cognitive and affective self-concepts and how they contribute to students' academic performance, especially in the vocational education setting. The significant and positive associations between these factors and academic achievement uncovered in this study provide a foundational understanding. However, the intricacies of their interaction, individual influence, and potential mediating factors might require more complex and diverse methodologies. Future research might explore different educational environments, age groups, and cultural contexts or employ longitudinal designs to capture developmental changes. Additionally, investigations into the practical applications of these insights, such as targeted interventions or curriculum adjustments, would contribute to a more comprehensive understanding of how educators can leverage students' self-concepts to enhance learning outcomes. This endeavour will enrich the existing body of knowledge and potentially lead to more effective educational strategies tailored to students' unique needs and characteristics within various educational frameworks

CONCLUSION

The present study has examined the impact of cognitive (X1) and affective (X2) academic self-concept on the academic accomplishment (Y) of students enrolled in vocational high schools. The Pearson correlation analysis, reliability test, multiple linear regression analysis, ANOVA, and coefficient analysis revealed a statistically significant and positive association between the two dimensions of self-concept and academic accomplishment. The regression model demonstrated an ability to account for roughly 49.1% of the variance in academic achievement, as indicated by the coefficient of determination R Square of .491 and Adjusted R Square of .485. The Variance Inflation Factor (VIF) did not provide substantial evidence of multicollinearity. The measurement instrument employed in this research exhibited satisfactory internal consistency, as evidenced by a Cronbach's Alpha coefficient of .708. The comprehensive results of this study offer substantiation for the significance of cognitive and affective academic self-concepts within the context of vocational education. Moreover, these findings suggest that further investigation and implementing interventions to enhance students' academic accomplishment could be built upon the foundation provided by these self-concepts.

REFERENCES

Adelson, J. L., & McCoach, D. B. (2011). Development and psychometric properties of the math and me survey: Measuring third through sixth graders' attitudes toward mathematics. *Measurement and Evaluation in Counseling and Development*, *44*(4), 225–247. https://doi.org/10.1177/0748175611418522

Anastasakis, M., Zakynthinaki, M., Trujillo-González, R., Garcia-Alonso, I., & Petridis, K. (2022). An Activity Theory approach in explaining engineering students' difficulties with university mathematics. *International Journal of Mathematical Education in Science and Technology*, *53*(6), 1571–1587. https://doi.org/10.1080/0020739X.2020.1834156

Arens, A. K., Jansen, M., Preckel, F., Schmidt, I., & Brunner, M. (2021). The structure of academic self-concept: A methodological review and empirical illustration of central models. *Review of Educational Research*, *91*(1), 34–72. https://doi.org/10.3102/0034654320972186

Arens, A. K., Marsh, H. W., Craven, R. G., Yeung, A. S., Randhawa, E., & Hasselhorn, M. (2016). Math self-concept in preschool children: Structure, achievement relations, and generalizability across gender. *Early Childhood Research Quarterly*, *36*, 391–403. https://doi.org/10.1016/j.ecresq.2015.12.024

Arens, A. K., Yeung, A. S., Craven, R. G., & Hasselhorn, M. (2011). The twofold multidimensionality of academic self-concept: Domain specificity and separation between competence and affect components. *Journal of Educational Psychology*, *103*(4), 970. https://doi.org/10.1037/a0025047

Boersma, A., ten Dam, G., Volman, M., & Wardekker, W. (2010). 'This baby... it isn't alive.'Towards a community of learners for vocational orientation. *British Educational Research Journal*, *36*(1), 3–25. https://doi.org/10.1080/01411920802642355

Brousseau, G. (2006). *Theory of didactical situations in mathematics: Didactique des mathématiques, 1970–1990* (Vol. 19). Springer Science & Business Media. https://doi.org/10.1007/0-306-47211-2

Brunner, M., Keller, U., Dierendonck, C., Reichert, M., Ugen, S., Fischbach, A., & Martin, R. (2010). The structure of academic self-concepts revisited: The nested Marsh/Shavelson model. *Journal of Educational Psychology*, *102*(4), 964. https://doi.org/10.1037/a0019644

Chen, G., & Tsurumi, H. (2010). Probit and logit model selection. *Communications in Statistics—Theory and Methods*, *40*(1), 159–175. https://doi.org/10.1080/03610920903377799

Chevallard, Y. (2015). Teaching mathematics in tomorrow's society: A case for an oncoming counter paradigm. *The Proceedings of the 12th International Congress on Mathematical Education: Intellectual and Attitudinal Challenges*, 173–187.

Chevallard, Y. (2019). Introducing the anthropological theory of the didactic: An attempt at a principled approach. *Hiroshima Journal of Mathematics Education*, *12*, 71–114.

Chevallard, Y., & Sensevy, G. (2014). Anthropological approaches in mathematics education, French perspectives. *Encyclopedia of Mathematics Education*, 38–43.

Cutuli, D. (2014). Cognitive reappraisal and expressive suppression strategies role in the emotion regulation: an overview on their modulatory effects and neural correlates. *Frontiers in Systems Neuroscience*, 175. https://doi.org/10.3389/fnsys.2014.00175

Dalby, D., & Noyes, A. (2016). Locating mathematics within post-16 vocational education in England. *Journal of Vocational Education & Training*, *68*(1), 70–86. https://doi.org/10.1080/13636820.2015.1110828

De Guzmán, M., Hodgson, B. R., Robert, A., & Villani, V. (1998). Difficulties in the passage from secondary to tertiary education. *Proceedings of the International Congress of Mathematicians*, *3*, 747–762.

Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory: A developmental, social cognitive, and sociocultural perspective on motivation. *Contemporary Educational Psychology*, *61*, 101859. https://doi.org/10.1016/j.cedpsych.2020.101859

Erten, I. H., & Burden, R. L. (2014). The relationship between academic self-concept, attributions, and L2 achievement. *System*, *42*, 391–401.

Ferm, L., Persson Thunqvist, D., Svensson, L., & Gustavsson, M. (2018). Students' strategies for learning identities as industrial workers in a Swedish upper secondary school VET programme. *Journal of Vocational Education & Training*, *70*(1), 66–84. https://doi.org/10.1080/13636820.2017.1394357

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2011). *How to design and evaluate research in education*. New York: McGraw-Hill Humanities/Social Sciences/Languages. https://pdfs.semanticscholar.org/60b6/99eda714ac21599455741fb499dd4e68f615.pdf

Green, A., Oketch, M. O., & Preston, J. (2009). Making global classifications of types and levels of TVET. In *International Handbook of Education for the Changing World of Work: Bridging Academic and Vocational Learning* (pp. 2067–2080). Springer. https://doi.org/10.1007/978-1-4020-5281-1

Guay, F., Marsh, H. W., & Boivin, M. (2003). Academic self-concept and academic achievement: Developmental perspectives on their causal ordering. *Journal of Educational Psychology*, *95*(1), 124. https://doi.org/10.1037/0022-0663.95.1.124

Guo, J., Marsh, H. W., Parker, P. D., Morin, A. J. S., & Dicke, T. (2017). Extending expectancy-value theory predictions of achievement and aspirations in science: Dimensional comparison processes and expectancy-by-value interactions. *Learning and Instruction*, *49*, 81–91.

Guy, G. M., Cornick, J., & Beckford, I. (2015). More than math: On the affective domain in developmental mathematics. *International Journal for the Scholarship of Teaching and Learning*, *9*(2), 7. https://doi.org/10.20429/ijsotl.2015.090207

Hammoudi, M. M. (2020). Measurement of students' mathematics motivation and self-concept at institutions of higher education: evidence of reliability and validity. *International Journal of Mathematical Education in Science and Technology*, *51*(1), 63–86. https://doi.org/10.1080/0020739X.2019.1670369

Harel, G. (2008). What is mathematics? A pedagogical answer to a philosophical question. In *Proof and other dilemmas: Mathematics and philosophy* (pp. 265–290). https://pdfs.semanticscholar.org/5f7d/bccaa85a33ef6a7d4a37e23e23a9ec436738.pdf

Hartog, J., Raposo, P., & Reis, H. (2022). Fluctuations in the wage gap between vocational and general secondary education: lessons from Portugal. *Journal of Population Economics*, *35*(2), 643–675. https://doi.org/10.1007/s00148-021-00846-1

Kahraman, N., Tas, Y., & Yerdelen, S. (2022). Engagement and Big-Fish-Little-Pond Effect on Self-Concept in Science: Findings from TIMSS 2011. *Excellence in Education Journal*, *11*(1), 88–119. https://eric.ed.gov/?id=EJ1346073

Karimova, K., & Csapó, B. (2021). Cognitive and affective components of verbal self-concepts and internal/external frame of reference within the multidimensional verbal domain. *SAGE Open*, *11*(2), 21582440211018684. https://doi.org/10.1177/2158244021101868

Marsh, H. W., Abduljabbar, A. S., Abu-Hilal, M., Morin, A. J. S., Abdelfattah, F., Leung, K. C., Xu, M. K., Nagengast, B., & Parker, P. (2013). Factor structure, discriminant and convergent validity of TIMSS math and science motivation measures: A comparison of USA and Saudi Arabia. *Journal of Educational Psychology*, *105*, 108–128. https://doi.org/10.1037/a0029907

Marsh, H. W., & Craven, R. (1996). Academic self-concept: Beyond the dustbowl. In *Handbook of classroom assessment* (pp. 131–198). Elsevier. https://doi.org/10.1016/B978-012554155-8/50008-9

Marsh, H. W., & Hattie, J. (1996). *Theoretical perspectives on the structure of self-concept.*

Marsh, H. W., & Hau, K.-T. (2004). Explaining paradoxical relations between academic self-concepts and achievements: Cross-cultural generalizability of the internal/external frame of reference predictions across 26 countries. *Journal of Educational Psychology*, *96*(1), 56. https://doi.org/10.1037/0022-0663.96.1.56

Marsh, H. W., & Martin, A. J. (2011). Academic self-concept and academic achievement: Relations and causal ordering. *British Journal of Educational Psychology*, *81*(1), 59–77. https://doi.org/10.1348/000709910X503501

Mazana, Y. M., Suero Montero, C., & Olifage, C. R. (2019). Investigating students' attitude towards learning mathematics. *International Electronic Journal of Mathematics Education*, *14*(1). https://doi.org/123456789/7398

Mndebele, C. B. S., & Dlamini, E. (2008). High school vocational programmes: self-reported perceptions of vocational teachers in Swaziland. *Journal of Vocational Education and Training*, *60*(3), 315–325. https://doi.org/10.1080/13636820802305660

Moon, K. (2020). New approaches for two-variable inequality graphs utilizing the Cartesian Connection and the APOS theory. *Educational Studies in Mathematics*, *104*(3), 351–367. https://doi.org/10.1007/s10649-020-09956-1

Mufune, P. (1999). Youth and development in Southern Africa: Achievements and challenges for the social sciences. *Development Southern Africa*, *16*(2), 357–369. https://doi.org/10.1080/03768359908440083

Mutohhari, F., Sutiman, S., Nurtanto, M., Kholifah, N., & Samsudin, A. (2021). Difficulties in Implementing 21st Century Skills Competence in Vocational Education Learning. *International Journal of Evaluation and Research in Education*, *10*(4), 1229–1236. https://doi.org/10.11591/ijere.v10i4.22028

Nagy, G., Trautwein, U., Baumert, J., Köller, O., & Garrett, J. (2006). Gender and course selection in upper secondary education: Effects of academic self-concept and intrinsic value. *Educational Research and Evaluation*, *12*(4), 323–345.

Nardi, E., & Steward, S. (2003). Is mathematics TIRED? A profile of quiet disaffection in the secondary mathematics classroom. *British Educational Research Journal*, *29*(3), 345–367. https://doi.org/10.1080/01411920301852

Norris, J. (2023). The positioning of GCSE and Functional Skills in Further Education: how do vocational students make sense of post-16 mathematics pathways? *Research in Mathematics Education*, *25*(1), 43–61. https://doi.org/10.1080/14794802.2021.2010239

Nurtanto, M., Kholifah, N., Masek, A., Sudira, P., & Samsudin, A. (2021). Crucial Problems in Arranged the Lesson Plan of Vocational Teacher. *International Journal of Evaluation and Research in Education*, *10*(1), 345–354. https://doi.org/10.11591/ijere.v10i1.20604.

Ogbunaya, T. C., & Udoudo, E. S. (2015). Repositioning Technical and Vocational Education and Training (TVET) for Youths Employment and National Security in Nigeria. *Journal of Education and Practice*, *6*(32), 141–147. http://files.eric.ed.gov/fulltext/EJ1083539.pdf

Pinxten, M., Marsh, H. W., De Fraine, B., Van Den Noortgate, W., & Van Damme, J. (2014). Enjoying mathematics or feeling competent in mathematics? Reciprocal effects on mathematics achievement and perceived math effort expenditure. *British Journal of Educational Psychology*, *84*(1), 152–174. https://doi.org/10.1111/bjep.12028

Seaton, M., Marsh, H. W., & Craven, R. G. (2010). Big-fish-little-pond effect: Generalizability and moderation—Two sides of the same coin. *American Educational Research Journal*, *47*(2), 390–433. https://doi.org/10.3102/0002831209350493

Suárez-Álvarez, J., Fernández-Alonso, R., & Muñiz, J. (2014). Self-concept, motivation, expectations, and socioeconomic level as predictors of academic performance in mathematics. *Learning and Individual Differences*, *30*, 118–123. https://doi.org/10.1016/j.lindif.2013.10.019

Takyi Mensah, E., Chen, M., Ntim, S. Y., & Gabrah, A. (2023). Analysing Dewey's vocational aspects of education and Maslow's theory of motivation in support of vocational education and training. *Discover Education*, *2*(1), 18. https://doi.org/10.1007/s44217-023-00042-1

Van Schaik, M., van Oers, B., & Terwel, J. (2010). Learning in the school workplace: knowledge acquisition and modelling in preparatory vocational secondary education. *Journal of Vocational Education & Training*, *62*(2), 163–181. https://doi.org/10.1080/13636820.2010.484629

Vergnaud, G. (1992). Conceptual fields, problem solving and intelligent computer tools. In *Computer-Based Learning Environments and Problem Solving* (pp. 287–308). Springer.

Wagner, M. M., Moore, A. W., & Aryel, R. M. (2011). *Handbook of biosurveillance*. Elsevier.

Wu, H., Guo, Y., Yang, Y., Zhao, L., & Guo, C. (2021). A meta-analysis of the longitudinal relationship between academic self-concept and academic achievement. *Educational Psychology Review*, 1–30. https://doi.org/10.1007/s10648-021-09600-1