

The Effect of Self-Directed Learning on Students' Motivation and Mathematical Disposition in Geometry Instruction

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Abstract

This study aims to analyze the direct and indirect effects of self-directed learning on students' learning motivation and mathematical disposition in geometry instruction. Self-directed learning is conceptualized within the framework of Self-Regulated Learning, while learning motivation and mathematical disposition are based on Self-Determination Theory. The study employed an explanatory quantitative approach with a cross-sectional survey design and was analyzed using Structural Equation Modeling. The sample consisted of 138 students selected through proportionate stratified random sampling from a population of students who had taken courses in basic geometry and analytic geometry. The instruments comprised three five-point Likert scales (48 items) that had been tested for validity and reliability. The analysis results showed that the model met the goodness-of-fit criteria (CMIN/DF = 2.14; CFI = 0.93; TLI = 0.92; RMSEA = 0.061; SRMR = 0.058). Learning autonomy had a significant positive effect on learning motivation ($\beta = 0.52$; $p < 0.001$) and mathematical disposition ($\beta = 0.31$; $p < 0.001$). Learning motivation had a significant positive effect on mathematical disposition ($\beta = 0.46$; $p < 0.001$). A bootstrap mediation test showed that learning motivation partially mediated the effect of learning autonomy on mathematical disposition (indirect effect = 0.239; 95% CI = 0.142–0.341). The model explained 27% of the variance in motivation and 41% of the variance in disposition. The findings underscore the importance of strengthening students' self-regulation and intrinsic motivation to improve Mathematical aptitude in geometry.

Keywords: independent learning, motivation to learn, mathematical disposition, geometry

Abstrak

Penelitian ini bertujuan menganalisis pengaruh langsung dan tidak langsung kemandirian belajar terhadap motivasi belajar dan disposisi matematis mahasiswa dalam pembelajaran geometri. Kemandirian belajar dipahami melalui kerangka Self-Regulated Learning, sementara motivasi belajar dan disposisi matematis didasarkan pada Self-Determination Theory. Penelitian menggunakan pendekatan kuantitatif eksplanatori dengan desain survei potong lintang, dianalisis menggunakan Structural Equation Modeling. Sampel berjumlah 138 mahasiswa yang dipilih melalui proportionate stratified random sampling dari populasi mahasiswa yang telah menempuh geometri dasar dan geometri analitik. Instrumen berupa tiga skala Likert lima tingkat (48 butir) yang telah diuji validitas dan reliabilitasnya. Hasil analisis menunjukkan model memenuhi kriteria goodness of fit (CMIN/DF=2,14; CFI=0,93; TLI=0,92; RMSEA=0,061; SRMR=0,058). Kemandirian belajar berpengaruh positif signifikan terhadap motivasi belajar ($\beta=0,52$; $p<0,001$) dan disposisi matematis ($\beta=0,31$; $p<0,001$). Motivasi belajar berpengaruh positif signifikan terhadap disposisi matematis ($\beta=0,46$; $p<0,001$). Uji mediasi bootstrap menunjukkan motivasi belajar memediasi secara parsial pengaruh kemandirian belajar terhadap disposisi matematis (pengaruh tidak langsung=0,239; 95% CI=0,142–0,341). Model menjelaskan 27% variasi motivasi dan 41%

variasi disposisi. Temuan menegaskan pentingnya penguatan regulasi diri dan motivasi intrinsik mahasiswa untuk meningkatkan disposisi matematis dalam pembelajaran geometri.

Kata Kunci: kemandirian belajar, motivasi belajar, disposisi matematis, pembelajaran geometri

Introduction

Mathematics education in higher education does not stop at mastering formulas, procedures, and computational techniques. Students need to develop a logical way of thinking, be able to explain the reasoning behind each step, check the consistency of arguments, and choose representations appropriate to the problem. In geometry instruction in particular, the demands of proof, spatial abstraction, and responsibility for the thought process make student independence a critical factor in learning success (Battista, 2007; Clements & Battista, 1992).

Learning autonomy, within the framework of Self-Regulated Learning (SRL), refers to an individual's ability to plan, monitor, adjust strategies, and reflect on their own learning process (Zimmerman, 2002, 2008; Pintrich, 2000). Panadero (2017) asserts that although there are various SRL models, nearly all of them place the planning-monitoring-reflection cycle at the core of effective self-regulation. This type of autonomy is thought to influence not only cognitive achievement but also students' motivation and affective dispositions toward mathematics (Boekaerts, 1999; Muis, 2007).

In this study, learning motivation is explained through Self-Determination Theory (SDT), which distinguishes between intrinsic motivation and internalized extrinsic motivation based on the fulfillment of basic psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2020). Meanwhile, mathematical disposition is understood as students' productive tendencies when facing mathematical problems, including self-confidence, persistence, curiosity, flexibility of thought, and a willingness to reflect on the process (Kilpatrick et al., 2001; National Council of Teachers of Mathematics [NCTM], 2000). Disposition is not merely a matter of liking or disliking something, but rather an affective tendency formed through repeated learning experiences (McLeod, 1992).

Previous research has shown a link between self-regulation and motivation and achievement in mathematics. Hwang et al. (2020) found that a social regulation-based online learning framework improved students' mathematics achievement and learning behaviors. Pajares and Graham (1999) reported that self-efficacy and other motivational constructs contribute to middle school students' mathematics performance. Middleton and Spanias (1999) and Hannula (2006) emphasized that motivation to learn mathematics is closely related to the emotions and dispositions that students bring to mathematical tasks. However, most of these studies examine partial relationships – such as the relationship between autonomy and motivation, or between motivation and disposition – without positioning motivation as a mediating mechanism within a comprehensive structural model, particularly in the context of geometry learning at the college level.

Geometry was chosen as the context because of its distinctive scientific nature: it requires deductive reasoning, visual-spatial representation, and formal proofs that demand more than just the application of procedures (Battista, 2007; Fischbein, 1993; van Hiele, 1986). In courses on elementary geometry and analytic geometry, students are confronted with problems that do not always have direct solution procedures, making the ability to plan an approach, monitor the progress of a proof, and revise strategies highly relevant. This research gap underlies the need for a model that simultaneously tests the direct effects of self-directed learning on motivation and mathematical disposition, as well as the mediating role of learning motivation between the two.

Based on the above discussion, this study aims to: (1) analyze the effect of self-directed learning on learning motivation; (2) analyze the effect of self-directed learning on

mathematical disposition; (3) analyze the effect of learning motivation on mathematical disposition; and (4) test the mediating role of learning motivation in the relationship between learning autonomy and students' mathematical disposition in geometry learning. The research hypotheses are formulated as follows: H1, learning autonomy has a significant positive effect on learning motivation; H2, learning autonomy has a significant positive effect on mathematical disposition; H3, learning motivation has a significant positive effect on mathematical disposition; and H4, learning motivation mediates the effect of learning autonomy on mathematical disposition.

Method

This study employed an explanatory quantitative approach with a cross-sectional survey design. The data were analyzed using Structural Equation Modeling (SEM) because self-directed learning, learning motivation, and mathematical disposition were treated as latent constructs represented by several indicators (Byrne, 2016; Hair et al., 2019; Kline, 2016). The analysis was conducted in two stages: measurement model evaluation to assess the relationship between indicators and constructs, and structural model evaluation to test the relationships among constructs. The study was conducted in the Mathematics Study Program, Faculty of Mathematics and Natural Sciences, Pamulang University, with primary data collection taking place from April to May 2025.

The accessible population consisted of 140 active students who had taken the courses Basic Geometry and Analytic Geometry. The sample was determined using proportionate stratified random sampling based on semester (strata), resulting in 138 respondents with complete data (a response rate of 98.6%), consisting of 63 fourth-semester students (45.7%), 52 sixth-semester students (37.7%), and 23 eighth-semester students (16.6%); 95 women (68.8%) and 43 men (31.2%).

The instrument consists of three five-point Likert scales (48 items): learning autonomy (18 items; the dimensions of planning, monitoring, strategy regulation, and reflection are based on Zimmerman's framework and the Motivated Strategies for Learning Questionnaire by Pintrich and De Groot, 1990), learning motivation (15 items; the dimensions of intrinsic and extrinsic/internalized motivation based on SDT), and mathematical disposition (15 items; the dimensions of self-confidence, persistence, curiosity, flexibility, and reflection, based on the concept of productive disposition, Kilpatrick et al., 2001). The instrument underwent content validity assessment by three experts, a pilot study involving 40 students outside the main sample, as well as construct validity testing via Confirmatory Factor Analysis (CFA) and construct reliability (Composite Reliability ≥ 0.70) with convergent validity (Average Variance Extracted ≥ 0.50) (Fornell & Larcker, 1981; Hu & Bentler, 1999).

Data were collected via an online questionnaire (Google Forms) over a four-week period, supplemented by brief interviews with 10 students to provide qualitative supporting data. Data analysis included: data cleaning and descriptive statistics; assumption testing (multivariate normality, multicollinearity, and outliers); measurement model evaluation (factor loadings, reliability, convergent validity); structural model evaluation using goodness-of-fit indices (CMIN/DF, CFI, TLI, RMSEA, SRMR); as well as testing hypotheses regarding direct and mediating effects using bootstrapping with 5,000 replications and a 95% confidence interval. An indirect effect is considered significant if the confidence interval does not include zero.

Results and Discussion

Descriptive Statistics

The descriptive statistics for the research variables are presented in Table 1.1.

Table 1. Descriptive Statistics of Research Variables

Variable	Mean	SD	Category
Learning autonomy	3,42	0,61	Moderate-High
Learning motivation	3,61	0,58	High
Mathematical disposition	3,35	0,64	Moderate

The mean score for learning motivation (3.61) was the highest among the three variables, followed by independent learning (3.42) and mathematical disposition (3.35). This pattern indicates that respondents tend to have a fairly strong motivation to learn, although this tendency is not yet fully matched by an equally high level of mathematical disposition.

Measurement Model: Construct Validity and Reliability

Hasil Confirmatory Factor Analysis (CFA) dan uji reliabilitas konstruk disajikan pada Tabel 2.

Table 2. Results of Construct Validity and Reliability Tests

Latent Variable	Loading Range	CR	AVE	Decision
Learning autonomy	0,52–0,81	0,87	0,54	Valid, Reliabel
Learning motivation	0,55–0,79	0,85	0,52	Valid, Reliabel
Mathematical disposition	0,54–0,83	0,88	0,55	Valid, Reliabel

All factor loadings were above the 0.50 threshold; the Composite Reliability (CR) values ranged from 0.85 to 0.88 (above the 0.70 threshold), and the Average Variance Extracted (AVE) is in the range of 0.52–0.55 (above the 0.50 threshold), so the instrument is deemed construct-valid and reliable (Fornell & Larcker, 1981; Hair et al., 2019). Assumption tests showed that the data met the criteria for multivariate normality (Mardia C.R. = 4.12 < 5.00), there was no indication of multicollinearity (VIF 1.21–1.58), and no significant multivariate outliers were found.

Structural Model Fit

Table 3. Structural Model Goodness-of-Fit Indices

Index	Cut-off	Result	Decision
CMIN/DF	< 3,00	2,14	Fit
CFI	≥ 0,90	0,93	Fit
TLI	≥ 0,90	0,92	Fit
RMSEA	≤ 0,08	0,061	Fit
SRMR	≤ 0,08	0,058	Fit

All five model fit indices met the established guidelines (Hu & Bentler, 1999), so the structural model was deemed suitable for testing the research hypotheses.

Testing Hypotheses on Direct Effects

Table 4. Results of Testing Hypotheses on Direct Effects

Hypothesis	Path	β	C.R.	p	Decision
H1	Autonomy → Motivation	0,52	6,14	< 0,001	Accepted
H2	Autonomy → Disposition	0,31	3,87	< 0,001	Accepted
H3	Motivation → Disposition	0,46	5,22	< 0,001	Accepted

The bootstrapping results indicate that learning motivation partially mediates the effect of learning autonomy on mathematical disposition (H4 accepted), with an indirect effect of

0.239 (95% CI=0.142–0.341, not including zero), while the direct effect of learning autonomy on mathematical disposition remains significant ($\beta=0.31$; $p<0.001$), resulting in a total effect of learning autonomy on mathematical disposition of 0.549. The model explains 27% of the variance in learning motivation ($R^2=0.27$) and 41% of the variance in mathematical disposition ($R^2=0.41$).

The research findings reveal a coherent sequence of influences: self-directed learning is strongly associated with learning motivation; learning motivation is strongly associated with mathematical disposition; and self-directed learning continues to exert a direct influence on disposition. These findings reinforce the argument that self-regulation provides the tools to manage the learning process, motivation provides the energy and reasons to remain engaged, while disposition is an affective tendency formed through repeated learning experiences (McLeod, 1992; Zimmerman, 2008). These three constructs are interrelated but conceptually distinct: autonomy focuses on process management, motivation focuses on reasons and energy, while disposition focuses on tendencies to respond to mathematical situations.

The effect of learning autonomy on learning motivation (H1: $\beta=0.52$; $p<0.001$) is the strongest pathway in this model. This coefficient indicates that a one-standard-deviation increase in autonomy is associated with an increase of approximately half a standard deviation in motivation. This finding is consistent with Self-Determination Theory, which states that motivation increases when the basic psychological needs for autonomy and competence are met (Deci & Ryan, 2000; Ryan & Deci, 2020). Students who are able to set goals, monitor their progress, and adjust their own learning strategies tend to experience a sense of control over the learning process (autonomy) as well as evidence of tangible progress (competence), and both of these experiences serve as sources of sustained motivation. These findings are consistent with Hwang et al. (2020), who demonstrated that a self-regulation-based learning framework enhances students' mathematics achievement and learning behaviors, as well as with Boekaerts (1999) and Muis (2007), who emphasized the close relationship between epistemic beliefs, self-regulation, and learning motivation. In the context of geometry specifically, the ability to determine the initial steps of a proof is crucial because many geometry problems do not provide a direct solution procedure (Battista, 2007); students who are able to analyze problems and choose synthetic, analytic, or vector approaches do not linger in aimless confusion, making it easier for a sense of competence and interest in the material to develop.

The effect of self-directed learning on mathematical disposition (H2: $\beta=0.31$; $p<0.001$) was weaker than its effect on motivation, but still significant. This pattern reinforces the hypothesis that self-directed learning does not influence disposition directly and fully, but is largely mediated through learning motivation—as confirmed by the results of the mediation test. Theoretically, this aligns with the idea that self-regulation skills alone (e.g., the ability to create a schedule or monitor time) are insufficient to foster productive affective tendencies such as self-confidence and perseverance without being accompanied by positive motivational experiences (Panadero, 2017; Pintrich, 2000). This finding is also relevant to Kilpatrick et al.'s (2001) perspective on productive disposition, which emphasizes that mathematical disposition is formed through repeated experiences of success and deriving meaning from the learning process, not merely from mastering regulatory techniques.

The effect of learning motivation on mathematical disposition (H3: $\beta = 0.46$; $p < 0.001$) is the second strongest path in the model. These results reinforce the findings of Middleton and Spanias (1999) and Hannula (2006), who confirmed that motivation to learn mathematics is closely related to the emotional responses and dispositions that students bring to mathematical tasks. Students with higher intrinsic motivation—who engage in geometry out of curiosity and the satisfaction of understanding, rather than solely for the sake of grades—tend to be more persistent in trying alternative strategies when encountering a roadblock, more open to errors as a source of learning, and more flexible in using representations (McLeod, 1992; Pajares &

Graham, 1999). Within Fischbein's (1993) framework of figural concepts, geometric reasoning requires the integration of conceptual and figural aspects; affective engagement driven by intrinsic motivation is hypothesized to help students persevere through this integration process rather than stopping at the stage of mere visual exploration.

The results of the mediation test (indirect effect = 0.239; 95% CI = 0.142–0.341) indicate that learning motivation partially – but not fully – mediates the effect of learning autonomy on mathematical disposition, as the direct path from autonomy to disposition remains significant even after motivation is included in the model. This partial mediation pattern has important theoretical implications: self-directed learning influences mathematical disposition through two simultaneous pathways—namely, a motivational pathway (via increased autonomy and competence) and a non-motivational pathway that may involve other mechanisms, such as the direct formation of cognitive-metacognitive habits (Zimmerman, 2002) or the accumulation of small successes that build self-confidence without requiring explicit changes in motivation. The total effect of autonomy on disposition, amounting to 0.549, confirms that strengthening learning autonomy remains a key lever, both directly and through motivation.

The R^2 value for learning motivation of 0.27 indicates that 73% of the variation in motivation is associated with other factors outside the model, such as self-efficacy (Bandura, 1997), task value and expectations of success (Eccles & Wigfield, 2020), teaching quality, or social support. Similarly, the R^2 value for disposition of 0.41 indicates that 59% of the variation in disposition is influenced by other factors, likely including prior mathematics learning experiences, math anxiety, and task characteristics. These R^2 values remain substantively meaningful, given that motivation and disposition are complex constructs influenced by many personal and contextual factors; however, this coefficient of determination also confirms that fostering self-directed learning is not the only strategy needed to build a productive mathematical disposition.

The theoretical implication of this finding is the importance of viewing motivation as a mediating mechanism that explains how self-regulation processes contribute to long-term affective tendencies. Autonomous learning is not merely a set of affectively neutral learning techniques; its influence on mathematical dispositions becomes stronger when these techniques generate positive motivational experiences. This implication aligns with Schunk and Zimmerman's (2008) view that self-regulation and motivation are two mutually reinforcing aspects of the learning process, rather than two separate constructs.

In practical terms, these findings suggest that strengthening students' mathematical dispositions in geometry learning cannot be achieved simply by encouraging them to be more confident or persistent; rather, it must be fostered through instructional designs that explicitly provide opportunities for students to plan, monitor, adjust their strategies, and reflect on their learning process – while also being designed to cultivate a sense of autonomy and competence. Some relevant concrete strategies include: (1) geometry assignments that require students to document their plans, the reasons for choosing a particular approach (synthetic, analytical, or vector-based), and the results of monitoring their progress in proving a theorem; (2) specific and actionable formative feedback – for example, pointing out definitions that have not been used correctly or invalid transitions in arguments – accompanied by opportunities for revision; (3) offering a choice of strategies or representations without compromising the quality standards of the argument, so that students experience autonomy without losing their way; and (4) classroom norms that treat errors as a source of information, not failure, in line with Schoenfeld's (1985) problem-solving approach. The program can also integrate consistent language and self-regulation tools across courses – such as learning journals, process rubrics, and reflection prompts – so that students can transfer self-regulation strategies from geometry to other mathematics courses.

This study has several limitations. First, the cross-sectional design does not allow for the observation of the sequence of changes over time, so inferences regarding causality and temporal mediation are limited; the term “effect” is used in accordance with structural equation modeling conventions but does not involve variable manipulation or random assignment. Second, the data are self-reported, which makes them susceptible to social desirability bias and differences in scale interpretation. Third, the sample was drawn from a single academic program at one university; therefore, generalizations to other contexts should be made with caution. Fourth, the model did not include other theoretically relevant variables, such as mathematical self-efficacy, math anxiety, and prior ability, which could potentially explain some of the variance in motivation and disposition that remains unexplained in this model.

Future research is recommended to use a longitudinal or experimental design to examine changes in autonomy, motivation, and mathematical disposition over time and to strengthen causal inferences; to include variables such as self-efficacy, math anxiety, and faculty support for autonomy as additional predictors or moderators; and to conduct cross-validation of the model in other university contexts and other mathematics courses to test the generalizability of the findings.

Conclusion

Learning autonomy has a positive and significant effect on learning motivation ($\beta=0.52$) and mathematical disposition ($\beta=0.31$); learning motivation has a positive and significant effect on mathematical disposition ($\beta=0.46$); and learning motivation partially mediates the effect of self-directed learning on mathematical disposition (indirect effect=0.239). The structural model meets the established fit criteria and explains 41% of the variance in mathematical disposition. These findings confirm that strengthening students’ mathematical disposition in geometry learning must be built through learning experiences that provide space for self-regulation while fostering intrinsic motivation, rather than through either one of these separately. These research results serve as a foundation for the development of geometry learning strategies that integrate support for autonomy, formative feedback, and process-based assessment, and open opportunities for further research using longitudinal or experimental designs to strengthen causal inferences.

References

- Bandura, A. (1997). Self-efficacy: The exercise of control. W. H. Freeman.
- Battista, M. T. (2007). The development of geometric and spatial thinking. In F. K. Lester Jr. (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 843–908). Information Age Publishing.
- Boekaerts, M. (1999). Self-regulated learning: Where we are today. *International Journal of Educational Research*, 31(6), 445–457.
- Byrne, B. M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming* (3rd ed.). Routledge.
- Clements, D. H., & Battista, M. T. (1992). Geometry and spatial reasoning. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 420–464). Macmillan.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.
- Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy-value theory. *Contemporary Educational Psychology*, 61, 101859.
- Fischbein, E. (1993). The theory of figural concepts. *Educational Studies in Mathematics*, 24(2), 139–162.

- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage.
- Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics*, 63(2), 165–178.
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis. *Structural Equation Modeling*, 6(1), 1–55.
- Hwang, G. J., Wang, S. Y., & Lai, C. L. (2020). Effects of a social regulation-based online learning framework on students' learning achievements and behaviors in mathematics. *Computers & Education*, 160, 104031.
- Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). *Adding it up: Helping children learn mathematics*. National Academy Press.
- Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). Guilford Press.
- McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 575–596). Macmillan.
- Middleton, J. A., & Spanias, P. A. (1999). Motivation for achievement in mathematics. *Journal for Research in Mathematics Education*, 30(1), 65–88.
- Muis, K. R. (2007). The role of epistemic beliefs in self-regulated learning. *Educational Psychologist*, 42(3), 173–190.
- National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Author.
- Pamungkas, A., Dewantari, T., Tohir, A., & Soraya, R. (2026). The Effectiveness of the Flipped Classroom Model in Improving English Reading Comprehension of Seventh-Grade Junior High School Students. *Journal of Cultural Analysis and Social Change*, 11(1), 999–1006. <https://doi.org/10.64753/jcasc.v11i1.4009>
- Pajares, F., & Graham, L. (1999). Self-efficacy, motivation constructs, and mathematics performance. *Contemporary Educational Psychology*, 24(2), 124–139.
- Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, 8, Article 422.
- Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). Academic Press.
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82(1), 33–40.
- Putra, H. S., Tohir, A., & Mashari, A. (2025). Analysis of Teacher' Digital Literacy Competencies as Support for Teachers' Skills at SDN 7 Gunung Agung. *Jurnal Evaluasi Dan Pembelajaran*, 7(2), 206–216. <https://doi.org/10.52647/jep.v7i2.400>
- Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective. *Contemporary Educational Psychology*, 61, 101860.
- Schoenfeld, A. H. (1985). *Mathematical problem solving*. Academic Press.
- Schunk, D. H., & Zimmerman, B. J. (Eds.). (2008). *Motivation and self-regulated learning: Theory, research, and applications*. Lawrence Erlbaum Associates.
- van Hiele, P. M. (1986). *Structure and insight: A theory of mathematics education*. Academic Press.
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice*, 41(2), 64–70.
- Zimmerman, B. J. (2008). Investigating self-regulation and motivation. *American Educational Research Journal*, 45(1), 166–183.