

**KECAKAPAN MEMBUAT MODEL MATEMATIS  
DAN DAYA JUANG PRODUKTIF SISWA KELAS VIII  
DALAM MEMECAHKAN MASALAH KONTEKSTUAL**

**TESIS**

**diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar  
Magister Pendidikan pada Program Studi Magister Pendidikan Matematika**



**oleh  
Khalida Rahmi  
NIM. 1906772**

**PROGRAM STUDI MAGISTER PENDIDIKAN MATEMATIKA  
FAKULTAS PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM  
UNIVERSITAS PENDIDIKAN INDONESIA  
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oleh  
Khalida Rahmi

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## HALAMAN PENGESAHAN

KHALIDA RAHMI

### KECAKAPAN MEMBUAT MODEL MATEMATIS DAN DAYA JUANG PRODUKTIF SISWA KELAS VIII DALAM MEMECAHKAN MASALAH KONTEKSTUAL

Disetujui dan disahkan oleh pembimbing:

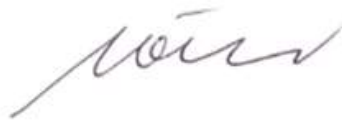
Pembimbing I



Prof. Dr. H. Tatang Herman, M.Ed.

NIP. 196210111991011001

Pembimbing II



Dr. Khusnul Novianingsih, S.Si., M.Si.

NIP. 197711282008122001

Mengetahui,

Ketua Departemen Pendidikan Matematika



Dr. H. Dadang Juandi, M.Si.

NIP. 196401171992021001

## ABSTRAK

**Rahmi, K. (2021). *Kecakapan Membuat Model Matematis dan Daya Juang Produktif Siswa Kelas VIII dalam Memecahkan Masalah Kontekstual*. (Tesis). Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam, Universitas Pendidikan Indonesia.**

Pemecahan masalah dengan menggunakan matematika dalam berbagai aspek kehidupan sehari-hari mendorong pentingnya kecakapan membuat model matematis siswa. Kesulitan terkait aspek-aspek membuat model matematis dapat menghambat kecakapan pemecahan masalah siswa, khususnya dalam memecahkan masalah dunia nyata atau kontekstual. Untuk mengatasi kesulitan tersebut, siswa perlu memiliki daya juang produktif. Penelitian ini membahas tentang kecakapan membuat model matematis dan daya juang produktif siswa kelas VIII dalam memecahkan masalah kontekstual. Tujuan dari penelitian ini adalah untuk menyelidiki kecakapan siswa dalam membuat model matematis beserta kesulitannya, dan daya juang produktif siswa dalam menghadapi kesulitan tersebut. Metode yang digunakan dalam penelitian ini adalah studi kasus yang terdiri dari: 1) tahap desain yang meliputi penentuan fokus penelitian, 2) tahap persiapan yang meliputi pengembangan instrumen penelitian, 3) tahap pengumpulan data yang meliputi pelaksanaan penyelidikan dengan menggunakan tes, kuesioner, dan wawancara, 4) tahap analisis data yang meliputi penjelasan hasil penyelidikan, dan 5) tahap pelaporan yang meliputi peninjauan dan penyusunan ulang seluruh tahapan penelitian. Hasil penelitian menunjukkan bahwa dalam memecahkan masalah kontekstual, capaian siswa pada umumnya hanya mencapai level 3 dari kompetensi membuat model matematis. Hal ini mencerminkan bahwa siswa mengalami kesulitan dalam proses membuat model matematis, terutama dalam mencapai level 4 dan level 5. Meskipun demikian, siswa memiliki daya juang produktif yang tinggi. Oleh karena itu, dapat disimpulkan bahwa siswa belum cakap dalam membuat model matematis. Guru dapat memanfaatkan daya juang produktif siswa untuk mengatasi kesulitan yang dialaminya sehingga siswa dapat meningkatkan kecakapannya.

**Kata Kunci:** Membuat Model Matematis, Daya Juang Produktif, Kesulitan Membuat Model Matematis, Masalah Kontekstual, Matematika SMP.

## ABSTRACT

**Rahmi, K. (2021). *The Mathematical Modelling Skills and Productive Struggles of 8<sup>th</sup> Graders in Solving Contextual Problems*. (Thesis). Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam, Universitas Pendidikan Indonesia.**

Problem-solving using mathematics in various aspects of daily life encourages the importance of students' mathematical modelling skills. Difficulties related to aspects of mathematical modelling can hinder students' problem-solving skills, especially in solving real-world or contextual problems. To overcome these difficulties, students need to have productive struggles. This research discusses the mathematical modelling skills and the productive struggles of 8<sup>th</sup> grade students in solving contextual problems. This research aims to investigate the students' mathematical modelling skills along with the difficulties, and their productive struggles in dealing with these difficulties. The case study method was used in this research which consists of: 1) the design stage that includes determining the research focus, 2) the preparation stage that includes developing the research instruments, 3) the data collection stage that includes conducting investigations by using test, questionnaires, and interview, 4) the data analysis stage that includes explaining the investigations results, and 5) the reporting stage that includes reviewing and rearranging all of the research stages. The results showed that in solving contextual problems, students' achievement in general only reached level 3 of the mathematical modelling competence. This reflects that the students are experiencing difficulties in the process of mathematical modelling, especially in achieving level 4 and level 5. However, they do have high productive struggles. Therefore, it can be concluded that the students are not yet competent in mathematical modelling. Teacher can utilize students' productive struggles to overcome students' difficulties so that they can improve their skills.

**Keywords:** Mathematical Modelling, Productive Struggle, Mathematical Modelling Difficulty, Contextual Problem, Middle School Mathematics.

## DAFTAR ISI

HALAMAN PENGESAHAN.....	ii
HALAMAN PERNYATAAN TENTANG KEASLIAN TESIS DAN PERNYATAAN BEBAS PLAGIARISME.....	iii
HALAMAN UCAPAN TERIMA KASIH.....	iv
ABSTRAK.....	v
ABSTRACT.....	vi
DAFTAR ISI.....	vii
DAFTAR TABEL.....	ix
DAFTAR GAMBAR.....	xii
DAFTAR LAMPIRAN.....	xiii
BAB I PENDAHULUAN.....	1
1.1 Latar Belakang Penelitian.....	1
1.2 Rumusan Masalah Penelitian.....	4
1.3 Tujuan Penelitian.....	5
1.4 Manfaat Penelitian.....	5
1.5 Struktur Organisasi Tesis.....	6
BAB II KAJIAN PUSTAKA.....	8
2.1 Model Matematis.....	8
2.2 Kecakapan Membuat Model Matematis.....	11
2.3 Kesulitan dalam Membuat Model Matematis.....	17
2.4 Daya Juang Produktif.....	20
2.5 Masalah Kontekstual.....	23
2.6 Penelitian Terdahulu.....	26
BAB III METODE PENELITIAN.....	31
3.1 Desain Penelitian.....	31
3.2 Definisi Operasional.....	33
3.3 Partisipan dan Tempat Penelitian.....	34
3.4 Instrumen Penelitian.....	34
3.5 Pengumpulan Data.....	35
3.6 Analisis Data.....	37

3.7	Validitas dan Reliabilitas.....	40
BAB IV TEMUAN DAN PEMBAHASAN.....		42
4.1	Tahap Persiapan.....	42
4.1.1	Instrumen Tes Kecakapan Membuat Model Matematis.....	42
4.1.2	Instrumen Kuesioner Kesulitan dalam Membuat Model Matematis.....	50
4.1.3	Instrumen Skala Daya Juang Produktif.....	53
4.1.4	Instrumen Pedoman Wawancara.....	55
4.2	Tahap Pengumpulan Data.....	56
4.2.1	Tes Kecakapan Membuat Model Matematis.....	57
4.2.2	Kuesioner Kesulitan dalam Membuat Model Matematis.....	59
4.2.3	Skala Daya Juang Produktif.....	63
4.2.4	Wawancara.....	67
4.3	Tahap Analisis Data.....	72
4.3.1	Kecakapan Membuat Model Matematis.....	72
4.3.2	Kesulitan dalam Membuat Model Matematis.....	80
4.3.3	Daya Juang Produktif.....	87
4.3.4	Interaksi antara Temuan-Temuan Penelitian.....	91
4.4	Keterbatasan Penelitian.....	102
BAB V SIMPULAN, IMPLIKASI, DAN REKOMENDASI.....		104
5.1	Simpulan.....	104
5.2	Implikasi.....	105
5.3	Rekomendasi.....	106
DAFTAR RUJUKAN.....		108
LAMPIRAN-LAMPIRAN.....		116

## DAFTAR RUJUKAN

- Arifin, S., Wahyudin, W., & Herman, T. (2020). The effects of contextual group guided discovery learning on students' mathematical understanding and reasoning. *Jurnal Prima Edukasia*, 8(2), 106–114. <https://doi.org/10.21831/jpe.v8i2.33059>
- Balitbang Kemendikbud. (2019). *Pendidikan di Indonesia: Belajar dari hasil PISA 2018*. Pusat Penilaian Pendidikan Balitbang Kemendikbud.
- Barbeau, E. (2009). Introduction. Dalam E. Barbeau & P. Taylor (Penyunting), *Challenging mathematics in and beyond the classroom: The 16th ICMI study* (hlm. 1–10). Springer.
- Blomhøj, M., & Jensen, T. H. (2007). What's all the fuss about competencies? Dalam W. Blum, P. L. Galbraith, H. W. Henn, & M. Niss (Penyunting), *Modelling and applications in mathematics education* (hlm. 45–56). Springer.
- Blomhøj, M., & Kjeldsen, T. H. (2006). Teaching mathematical modelling through project work. *ZDM Mathematics Education*, 38(2), 385–395.
- Blum, W. (2011). Can modelling be taught and learnt? Some answers from empirical research. Dalam G. Kaiser, W. Blum, R. Borromeo Ferri, & G. Stillman (Penyunting), *Trends in teaching and learning of mathematical modelling* (hlm. 15–30). Springer.
- Blum, W., & Borromeo Ferri, R. (2009). Mathematical modelling: Can it be taught and learnt? *Journal of Mathematical Modelling and Application*, 1(1), 45–58.
- Brown, J. P. (2020). Expectations for challenge in modelling and its assessment. Dalam G. Stillman, G. Kaiser, & C. Lampen (Penyunting), *Mathematical modelling education education and sense-making* (hlm. 253–263). Springer. <https://doi.org/10.1007/978-3-030-37673-4>
- Chang, Y.-P., Krawitz, J., Schukajlow, S., & Yang, K.-L. (2019). Comparing German and Taiwanese secondary school students' knowledge in solving mathematical modelling tasks requiring their assumptions. *ZDM*, 52(1), 59–72. <https://doi.org/10.1007/s11858-019-01090-4>



- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications, Inc.
- Fancsali, S. E., Holstein, K., Sandbothe, M., Ritter, S., McLaren, B. M., & Alevan, V. (2020). Towards Practical Detection of Unproductive Struggle. *Lecture Notes in Computer Science*, 92–97. [https://doi.org/10.1007/978-3-030-52240-7\\_17](https://doi.org/10.1007/978-3-030-52240-7_17)
- Fonteles Furtado, P. G., Hirashima, T., Hayashi, Y., & Maeda, K. (2019). Application focused on structural comprehension of mathematics contextual problems for kindergarten students. *Research and Practice in Technology Enhanced Learning*, 14(1). <https://doi.org/10.1186/s41039-019-0096-1>
- Freudenthal, H. (1968). Why to teach mathematics so as to be useful. *Educational Studies in Mathematics*, 1(1), 3–8.
- Freudenthal, H. (1991). *Revisiting mathematics education*. Kluwer Academic Publishers.
- Galbraith, P., Holton, D., & Turner, R. (2020). Rising to the challenge: Promoting mathematical modelling as real-world problem solving. Dalam G. Stillman, G. Kaiser, & C. Lampen (Penyunting), *Mathematical modelling education and sense-making* (hlm. 253–263). Springer. <https://doi.org/10.1007/978-3-030-37673-4>
- Galbraith, P. L., Stillman, G., & Brown, J. (2013). Turning ideas into modeling problems. Dalam R. Lesh, P. L. Galbraith, C. R. Haines, & A. Hurford (Penyunting), *Modeling students' mathematical modeling competencies: ICTMA 13* (hlm. 133–144). Springer. <https://doi.org/10.1007/978-94-007-6271-8>
- Geiger, V., Stillman, G., Brown, J., Galbriath, P., & Niss, M. (2017). Using mathematics to solve real world problems: The role of enablers. *Mathematics Education Research Journal*, 30(1), 7–19. <https://doi.org/10.1007/s13394-017-0217-3>
- Gibbs, G. R. (2007). Analyzing qualitative data. Dalam U. Flick (Penyunting), *The SAGE qualitative research kit*. SAGE Publications, Inc.
- Gould, H., & Wasserman, N. H. (2014). Striking a balance: Students' tendencies to oversimplify or overcomplicate in mathematical modeling. *Journal of*

- Mathematics Education at Teachers College*, 5(1), 27–34.  
<https://doi.org/10.7916/jmetc.v5i1.640>
- Granberg, C. (2016). Discovering and addressing errors during mathematics problem-solving—A productive struggle? *The Journal of Mathematical Behavior*, 42, 33–48. <https://doi.org/10.1016/j.jmathb.2016.02.002>
- Gravemeijer, K. (1997). Mediating between concrete and abstract. Dalam T. Nunes & P. Bryant (Penyunting), *Learning and teaching mathematics: An International perspective* (hlm. 315–343). Erlbaum.
- Gravemeijer, K., & Doorman, M. (1999). Context problems in Realistic Mathematics Education: A calculus course as an example. *Educational Studies in Mathematics*, 39(1/3), 111–129. <https://doi.org/10.1023/a:1003749919816>
- Greefrath, G., & Vorhölter, K. (2016). Teaching and learning mathematical modelling. Dalam *ICME-13 Topical Surveys*. Springer International Publishing. <https://doi.org/10.1007/978-3-319-45004-9>
- Haines, C. R., & Crouch, R. (2013). Remarks on a modeling cycle and interpreting behaviours. Dalam R. Lesh, P. L. Galbraith, C. R. Haines, & A. Hurford (Penyunting), *Modeling students' mathematical modeling competencies: ICTMA 13* (hlm. 145–154). Springer. <https://doi.org/10.1007/978-94-007-6271-8>
- Hankeln, C., Adamek, C., & Greefrath, G. (2019). Assessing sub-competencies of mathematical modelling—Development of a new test instrument. Dalam G. A. Stillman & J. P. Brown (Penyunting), *Lines of inquiry in mathematical modelling research in education* (hlm. 143–160). Springer International Publishing.
- Harland, T. (2014). Learning about case study methodology to research higher education. *Higher Education Research & Development*, 33(6), 1113–1122. <https://doi.org/10.1080/07294360.2014.911253>
- Hastings, S. L. (2010). Triangulation. Dalam N. J. Salkind (Penyunting), *Encyclopedia of research design* (hlm. 1537–1540). SAGE Publications, Inc.
- Henn, H.-W., & Maaß, K. (2003). Standardthemen im realitätsbezogenen Mathematikunterricht. Dalam W. Henn & K. Maaß (Penyunting), *Materialien*

- für einen realitätsbezogenen Mathematikunterricht: Bd. 8 (ISTRON) (hlm. 1–5). Franzbecker.
- Henning, H., & Keune, M. (2007). Levels of modelling competencies. Dalam W. Blum, P. L. Galbraith, H. W. Henn, & M. Niss (Penyunting), *Modelling and applications in mathematics education* (hlm. 225–232). Springer US.
- Herman, T. (2007). Pembelajaran berbasis masalah untuk meningkatkan kemampuan berpikir matematis tingkat tinggi siswa sekolah menengah pertama. *Educationist*, 1(1), 47–56.
- Hestenes, D. (2013). Modeling theory for math and science education. Dalam R. Lesh, P. L. Galbraith, C. R. Haines, & A. Hurford (Penyunting), *Modeling students' mathematical modeling competencies: ICTMA 13* (hlm. 13–41). Springer. <https://doi.org/10.1007/978-94-007-6271-8>
- Hiebert, J., & Grouws, D. A. (2007). The effects of classroom mathematics teaching on students' learning. Dalam F. K. Lester (Penyunting), *Second handbook of research on mathematics teaching and learning* (hlm. 371–404). Information Age Publishing.
- Jupri, A., & Drijvers, P. (2016). Student difficulties in mathematizing word problems in algebra. *EURASIA Journal of Mathematics, Science and Technology Education*, 12(9), 2481–2502. <https://doi.org/10.12973/eurasia.2016.1299a>
- Jupri, A., Drijvers, P., & van den Heuvel-Panhuizen, M. (2014). Difficulties in initial algebra learning in Indonesia. *Mathematics Education Research Journal*, 26(4), 683–710. <https://doi.org/10.1007/s13394-013-0097-0>
- Kaiser, G. (2014). Mathematical modelling and applications in education. Dalam S. Lerman (Penyunting), *Encyclopedia of mathematics education* (hlm. 396–404). Springer Netherlands. <https://doi.org/10.1007/978-94-007-4978-8>
- Kaiser, G. (2017). The teaching and learning of mathematical modeling. Dalam J. Cai (Penyunting), *Compendium for research in mathematics education* (hlm. 267–291). National Council of Teachers of Mathematics.
- Lesh, R., & Fennewald, T. (2013). Introduction to part I modeling: What is it? Why do it? Dalam R. Lesh, P. L. Galbraith, C. R. Haines, & A. Hurford (Penyunting), *Modeling students' mathematical modeling competencies:*

- ICTMA 13* (hlm. 5–10). Springer. <https://doi.org/10.1007/978-94-007-6271-8>
- Ludwig, M., & Xu, B. (2010). A comparative study of modelling competencies among Chinese and German students. *Journal Für Mathematik-Didaktik*, 31(1), 77–97. <https://doi.org/10.1007/s13138-010-0005-z>
- Maaß, K. (2006). What are modelling competencies? *ZDM*, 38(2), 113–142. <https://doi.org/10.1007/bf02655885>
- Manouchehri, A., Bekdemir, M., & Yao, X. (2020). Facilitating modelling activities in a grade 5 classroom. Dalam G. Stillman, G. Kaiser, & C. Lampen (Penyunting), *Mathematical modelling education education and sense-making* (hlm. 187–197). Springer. <https://doi.org/10.1007/978-3-030-37673-4>
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. SAGE Publications, Inc.
- Mueller, M., Yankelewitz, D., & Maher, C. (2014). Teachers promoting student mathematical reasoning. *Investigations in Mathematics Learning*, 7(2), 1–20. <https://doi.org/10.1080/24727466.2014.11790339>
- Mullis, I. V. S., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics*. TIMSS & PIRLS International Study Center.
- Neidorf, T., Arora, A., Erberber, E., Tsokodayi, Y., & Mai, T. (2020). Student misconceptions, errors, and misunderstandings in physics and mathematics: Exploring data from TIMSS and TIMSS advanced. Dalam *IEA Research for Education*. Springer. <https://doi.org/10.1007/978-3-030-30188-0>
- Niss, M. (2003). Mathematical competencies and the learning of mathematics: The Danish KOM project. Dalam A. Gagtsis & S. Papastavridis (Penyunting.), *3rd Mediterranean conference on mathematical education* (hlm. 115–124). The Hellenic Mathematical Society.
- Niss, M. (2013). Modeling a crucial aspect of students' mathematical modeling. Dalam R. Lesh, P. L. Galbraith, C. R. Haines, & A. Hurford (Penyunting), *Modeling students' mathematical modeling competencies: ICTMA 13* (hlm. 43–59). Springer. <https://doi.org/10.1007/978-94-007-6271-8>

- Niss, M., Blum, W., & Galbraith, P. (2007). Introduction. Dalam W. Blum, P. L. Galbraith, H. W. Henn, & M. Niss (Penyunting), *Modelling and applications in mathematics education* (hlm. 3–32). Springer US.
- OECD. (2018). *PISA for development assessment and analytical framework: Reading, mathematics and science*. OECD Publishing. <http://dx.doi.org/10.1787/9789264305274-en>
- Ortiz, J., & Santos, A. D. (2011). Mathematical modelling in secondary education: A case study. Dalam G. Kaiser, W. Blum, R. Borromeo Ferri, & G. Stillman (Penyunting), *Trends in teaching and learning of mathematical modelling* (hlm. 127–135). Springer.
- Paulos, J. A. (2000). *Innumeracy: mathematical illiteracy and its consequences*. Penguin.
- Peled, I. (1997). Forms of passiveness encoding and risk taking of poor math learners. *International Journal of Mathematical Education in Science and Technology*, 28(4), 581–589. <https://doi.org/10.1080/0020739970280413>
- Reinke, L. T. (2019). Contextual problems as conceptual anchors: An illustrative case. *Research in Mathematics Education*, 22(1), 3–21. <https://doi.org/10.1080/14794802.2019.1618731>
- Rushton, S. J. (2018). Teaching and learning mathematics through error analysis. *Fields Mathematics Education Journal*, 3(1). <https://doi.org/10.1186/s40928-018-0009-y>
- Schaap, S., Vos, P., & Goedhart, M. (2011). Students overcoming blockages while building a mathematical model: Exploring a framework. Dalam G. Kaiser, W. Blum, R. Borromeo Ferri, & G. Stillman (Penyunting), *Trends in teaching and learning of mathematical modelling* (hlm. 137–146). Springer.
- Schwartz, D. L., & Martin, T. (2004). Inventing to prepare for future learning: The hidden efficiency of encouraging original student production in statistics instruction. *Cognition and Instruction*, 22(2), 129–184. [https://doi.org/10.1207/s1532690xci2202\\_1](https://doi.org/10.1207/s1532690xci2202_1)
- Setiawati, S., Herman, T., & Jupri, A. (2020). Analysis of Indonesian students' error in solving mathematical literacy problems based on PISA 2015 results. *Jurnal*

*Pendidikan MIPA*, 21(1), 67–77.  
<https://doi.org/10.23960/jpmipa/v21i1.pp67-77>

- Shahbari, J. A., & Peled, I. (2015). Modelling in Primary School: Constructing Conceptual Models and Making Sense of Fractions. *International Journal of Science and Mathematics Education*, 15(2), 371–391.  
<https://doi.org/10.1007/s10763-015-9702-x>
- Speiser, B., & Walter, C. (2013). Models as tools, especially for making sense of problems. Dalam R. Lesh, P. L. Galbraith, C. R. Haines, & A. Hurford (Penyunting), *Modeling students' mathematical modeling competencies: ICTMA 13* (hlm. 167–172). Springer. <https://doi.org/10.1007/978-94-007-6271-8>
- Stake, R. E. (1995). *The art of case study research*. SAGE Publications, Inc.
- Stillman, G. A. (2019). State of the art on modelling in mathematics education—lines of inquiry. Dalam G. A. Stillman & J. P. Brown (Penyunting), *Lines of inquiry in mathematical modelling research in education* (hlm. 1–20). Springer International Publishing.
- Sugiyono. (2010). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Alfabeta.
- Sullivan, P., Bobis, J., Downton, A., Feng, M., Hughes, S., Livy, S., McCormick, M., & Russo, J. (2020). Threats and opportunities in remote learning of mathematics: Implication for the return to the classroom. *Mathematics Education Research Journal*, 32(3), 551–559.  
<https://doi.org/10.1007/s13394-020-00339-6>
- van den Heuvel-Panhuizen, M. (2003). The didactical use of models in realistic mathematics education: An example from a longitudinal trajectory on percentage. *Educational Studies in Mathematics*, 54(1), 9–35.  
<https://doi.org/10.1023/b:educ.0000005212.03219.dc>
- van Stiphout, I., Drijvers, P., & Gravemeijer, K. (2013). The development of students' algebraic proficiency. *International Electronic Journal of Mathematics Education*, 8(2-3), 62–80.
- Verschaffel, L., Schukajlow, S., Star, J., & Van Dooren, W. (2020). Word problems in mathematics education: A survey. *ZDM*, 52(1), 1–16.  
<https://doi.org/10.1007/s11858-020-01130-4>

- Walker, D.F. & Hess, R.D. (1984). *Instructional Software: Principles and Perspectives for Design and Use*. Wadsworth Publishing Company.
- Warshauer, H. K. (2014). Productive struggle in middle school mathematics classrooms. *Journal of Mathematics Teacher Education*, 18(4), 375–400. <https://doi.org/10.1007/s10857-014-9286-3>
- Warshauer, H. K. (2015). Strategies to support productive struggle. *Mathematics Teaching in the Middle School*, 20(7), 390. <https://doi.org/10.5951/mathteachmiddscho.20.7.0390>
- Wess, R., Klock, H., Siller, H.-S., & Greefrath, G. (2021). Measuring professional competence for the teaching of mathematical modelling. Dalam *International Perspectives on the Teaching and Learning of Mathematical Modelling*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-78071-5>
- Widjaja, W. (2013). The use of contextual problems to support mathematical learning. *Journal on Mathematics Education*, 4(2). <https://doi.org/10.22342/jme.4.2.413.151-159>
- Wijaya, A., Van den Heuvel-Panhuizen, M., Doorman, M., & Robitzsch, A. (2014). Difficulties in solving context-based PISA mathematics tasks: An analysis of students' errors. *The Mathematics Enthusiast*, 11(3), 555–584.
- Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications, Inc.
- Zubi, I. A., Peled, I., & Yarden, M. (2019). Modelling tasks and students with mathematical difficulties. Dalam G. A. Stillman & J. P. Brown (Penyunting), *Lines of inquiry in mathematical modelling research in education* (hlm. 213–231). Springer International Publishing.