

## Appendix

#	Authors	Year	Title	Participants/Data source	Level of Education	Research Method	Research Focus
1	Mononen, R., & Aunio, P.	2013	Early Mathematical Performance in Finnish Kindergarten and Grade One	K-12 students (KG, grade 1)	Primary education	Quantitative	Mathematics learners and learning
2	Milner-Bolotin, M., Fisher, H., & MacDonald, A.	2013	Modeling Active Engagement Pedagogy through Classroom Response Systems in a Physics Teacher Education Course	Pre-service teachers	Higher education	Mixed	STEM education
3	Ambrus, A., & Barczy-Veres, K.	2015	Using open problems and cooperative methods in mathematics education	K-12 students (16 - 17 years old)	Secondary education	Mixed	Mathematics learners and learning
4	Chapman, O.	2015	Mathematics teachers' knowledge for teaching problem solving	Published materials	All	Conceptual	Mathematics teachers and teaching
5	Fülöp, E.	2015	Teaching problem-solving strategies in mathematics	K-12 students (16 - 17 years old)	Secondary education	Mixed	Mathematics teachers and teaching
6	Koponen, M.	2015	Teacher's instruction in the reflection phase of the problem solving process	K-12 teachers (grade 5)	Primary education	Qualitative	Mathematics teachers and teaching

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7	Kuzle, A.	2015	Problem solving as an instructional method: The use of open problems in technology problem solving instruction	Pre-service teachers Faculty members	Higher education	Qualitative	Mathematics teachers and teaching
8	Laine, A., Ahtee, M., Näveri, L., Pehkonen, E., Koivisto, P. P., & Tuohilampi, L.	2015	Collective emotional atmosphere in mathematics lesson based on Finnish fifth graders' drawings	K-12 students (grade 5)	Primary education	Qualitative	Mathematics learners and learning
9	Mason, J.	2015	On being stuck on a mathematical problem: What does it mean to have something come-to-mind?	Published materials	All	Conceptual	Mathematics learners and learning
10	Rott, B.	2015	Rethinking heuristics – characterizations and vignettes	Published materials	All	Conceptual	Mathematics learners and learning
11	Viitala, H.	2015	Two Finnish girls and mathematics: Similar achievement level, same core curriculum, different competences	K-12 students (grade 9)	Primary education	Qualitative	Mathematics learners and learning

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12	Namsone, D., Čakāne, L., & France, I.	2015	How science teachers learn to reflect by analyzing jointly observed lessons	K-12 teachers	Primary education Secondary education	Mixed	Mathematics teachers and teaching
13	Kuzle, A.	2015	Nature of metacognition in a dynamic geometry environment	Pre-service teachers	Higher education	Qualitative (Case study)	Mathematics learners and learning
14	Heikkinen, H., Hästö, P., Kangas, V., & Leinonen, M.	2015	Promoting Exploratory Teaching in Mathematics: A Design Experiment on a CPD course for Teachers	K-12 teachers Pre-service teachers	Primary education Secondary education	Qualitative	Mathematics teachers and teaching
15	Rossi, M.	2015	Mathematics can be meaningful, easy and fun.	Published materials	All	Conceptual	Mathematics learners and learning
16	Ekstam, U., Linnanmäki, K., & Aunio, P.	2017	The Impact of Teacher Characteristics on Educational Differentiation Practices in Lower Secondary Mathematics Instruction	K-12 teachers	Secondary education	Quantitative	Mathematics teachers and teaching
17	Kojo, A., Laine, A., & Näveri, L.	2018	How did you solve it? – Teachers' approaches to guiding mathematics problem solving	K-12 teachers	Primary education	Qualitative	Mathematics teachers and teaching

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18	Milner-Bolotin, M., & Marotto, C. C. F.	2018	Parental engagement in children's STEM education. Part I: Meta-analysis of the literature	Published materials	All	Quantitative	STEM education
19	Marotto, C. C. F., & Milner-Bolotin, M.	2018	Parental engagement in children's STEM education. Part II: Parental attitudes and motivation	Parents	Primary education Secondary education	Mixed	STEM education
20	Laine, A., Ahtee, M., Näveri, L., Pehkonen, E., & Hannula, M. S.	2018	Teachers' influence on the quality of pupils' written explanations – Third-graders solving a simplified arithmagon task during a mathematics lesson	K-12 teachers K-12 students (grade 3)	Primary education	Qualitative	Mathematics teachers and teaching
21	Meier, A., Hannula, M. S., & Toivanen, M.	2018	Mathematics and outdoor photography experience – exploration of an approach to mathematical education, based on the theory of Dewey's aesthetics	Pre-service teachers	Higher education	Mixed	Mathematics teachers and teaching

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22	Viholainen, A., Tossavainen, T., Viitala, H., & Johansson, M.	2019	University mathematics students' self-efficacy beliefs about proof and proving	Undergraduate students	Higher education	Mixed	Mathematics learners and learning
23	Haataja, E., Toivanen, M., Laine, A., & Hannula, M. S.	2019	Teacher-student eye contact during scaffolding collaborative mathematical problem-solving	K-12 teachers	Primary education	Quantitative	Mathematics teachers and teaching
24	Hatisaru, V.	2019	Lower secondary students' views about mathematicians depicted as mathematics teachers	K-12 students (grades 6,7,8)	Primary education	Qualitative	Mathematics learners and learning
25	Lake, E.	2019	'Playing it safe' or 'throwing caution to the wind': Risk-taking and emotions in a mathematics classroom	K-12 teachers	Secondary education	Qualitative	Mathematics teachers and teaching
26	Manderfeld, K. A.-M., & Siller, H.-S.	2019	Pre-Service mathematics teachers' beliefs regarding topics of mathematics education	Pre-service teachers	Higher education	Qualitative	Mathematics teachers and teaching

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27	Nyman, M., & Sumpter, L.	2019	The issue of 'proudliness': Primary students' motivation towards mathematics	K-12 students (grades 2 and 5)	Primary education	Mixed	Mathematics learners and learning
28	Portaankorva-Koivisto, P., & Grevholm, B.	2019	Prospective mathematics teachers' self-referential metaphors as indicators of the emerging professional identity	Pre-service teachers	Higher education	Qualitative	Mathematics teachers and teaching
29	Suriakumar, N., Hannula, M. S., & Vollstedt, M.	2019	Investigation of Finnish and German 9th grade students' personal meaning with relation to mathematics	K-12 students (grade 9)	Primary education	Quantitative	Mathematics learners and learning
30	Wadanambi, G. M., & Leung, F. K. S.	2019	Exploring the influence of pre-service mathematics teachers' professed beliefs on their practices in the Sri Lankan context	Pre-service teachers	Higher education	Mixed	Mathematics teachers and teaching
31	Sterner, H. E. K.	2019	Teachers as actors in an educational design research: What is behind the generalized formula?	K-12 teachers (grades 1 to 6)	Primary education	Qualitative	Mathematics teachers and teaching

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32	Kuzle, A.	2019	Design and evaluation of practice-oriented materials fostering students' development of problem-solving competence	K-12 students (grade 5)	Primary education	Mixed	Mathematics learners and learning
33	Hannula, J.	2019	Characteristics of teacher knowledge produced by pre-service mathematics teachers: the case of open-ended problem-based learning	Pre-service teachers	Higher education	Qualitative	Mathematics teachers and teaching
34	Kaarakka, T., Helkala, K., Valmari, A., & Joutsenlahti, M.	2019	Pedagogical experiments with MathCheck in university teaching	Undergraduate students Faculty members	Higher education	Mixed	Mathematics learners and learning
35	Lehtonen, D., Jyrkiäinen, A., & Joutsenlahti, J.	2019	A systematic review of educational design research in Finnish doctoral dissertations on mathematics, science, and technology education	Published materials	Higher education	Conceptual	STEM education

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36	Alfaro Viquez, H., & Joutsenlahti, J.	2020	Promoting learning with understanding: Introducing languaging exercises in calculus course for engineering students at the university level	Undergraduate students	Higher education	Qualitative	Mathematics learners and learning
37	Cardino Jr., J. M., & Ortega-Dela Cruz, R. A.	2020	Understanding of learning styles and teaching strategies towards improving the teaching and learning of mathematics	K-12 students (grade 9)	Primary education	Quantitative	Mathematics teachers and teaching
38	Grundén, H.	2020	Planning in mathematics teaching – a varied, emotional process influenced by others	K-12 teachers Principles	Primary education	Qualitative	Mathematics teachers and teaching
39	Haataja, E., Laine, A., & Hannula, M.	2020	Educators' perceptions of mathematically gifted students and a socially supportive learning environment – A case study of a Finnish upper secondary school	K-12 teachers Principles	Secondary education	Qualitative	Mathematics teachers and teaching



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40	Luoto, J.	2020	Scrutinizing two Finnish teachers' instructional rationales and perceived tensions in enacting student participation in mathematical discourse	K-12 teachers	Primary education	Qualitative	Mathematics teachers and teaching
41	Sunzuma, G., Chando, C., Gwizangwe, I., Zezekwa, N., & Zinyeka, G.	2020	In-service Zimbabwean teachers' views on the utility value of diagrams in the teaching and learning of geometry	K-12 teachers	Secondary education	Mixed	Mathematics teachers and teaching
42	Tomperi, P., Ryzhkova, I., Shestova, Y., Lyash, O., Lazareva, I., Lyash, A., Kvivesen, M., Manshadi, S., & Uteng, S.	2020	The three-factor model: A study of common features in students' attitudes towards studying and learning science and mathematics in the three countries of the North Calotte region	K-12 students	Primary education	Quantitative	Mathematics learners and learning

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43	Tossavainen, T., Gröhn, J., Heikkinen, L., Kaasinen, A., & Viholainen, A.	2020	University mathematics students' study habits and use of learning materials	Undergraduate students	Higher education	Quantitative	Mathematics learners and learning
44	Viro, E., & Joutsenlahti, J.	2020	Learning mathematics by project work in secondary school	K-12 students	Secondary education	Qualitative	Mathematics learners and learning
45	White, D., & Delaney, S.	2021	Full STEAM ahead, but who has the map? – A PRISMA systematic review on the incorporation of interdisciplinary learning into schools	Published materials	All	Conceptual	STEM education
46	Cabello, V. M., Martinez, M. L., Armijo, S., & Maldonado, L.	2021	Promoting STEAM learning in the early years: "Pequeños Científicos" Program	K-12 students K-12 teachers	Primary education	Qualitative	STEM education

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47	Gorgorió, N., Albarracín, L., Laine, A., & Llinares, S.	2021	Primary education degree programs in Alicante, Barcelona and Helsinki: Could the differences in the mathematical knowledge of incoming students be explained by the access criteria?	Pre-service teachers	Higher education	Quantitative	Mathematics teachers and teaching
48	Moate, J., Kuntze, S., & Chan, M. C. E.	2021	Student participation in peer interaction – Use of material resources as a key consideration in an open-ended problem-solving mathematics task	K-12 students (grade 7)	Primary education	Qualitative	Mathematics learners and learning
49	Mohamed, R., Ghazali, M., & Samsudin, M. A.	2021	A systematic review on teaching fraction for understanding through representation on Web of Science database using PRISMA	Published materials	Primary education	Conceptual	Mathematics learners and learning
50	Pörn, R., Hemmi, K., & Kallio-Kujala, P.	2021	Inspiring or confusing – a study of Finnish 1–6 teachers' relation to teaching programming	K-12 teachers	Primary education	Mixed	Mathematics teachers and teaching

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51	Yeşilyurt Çetin, A., & Dikici, R.	2021	Organizing the mathematical proof process with the help of basic components in teaching proof: Abstract algebra example	Faculty members	Higher education	Qualitative	Mathematics teachers and teaching