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Supplementary Material

1 List of reviewed studies

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Greefrath, G., & Hertleif, C. (2016). Mathematisches Modellieren mit digitalen Werkzeugen—Eine Fallstudie mit Dynamischer Geometrie-Software. *Beiträge zum Mathematikunterricht 2016*, 425–428. http://dx.doi.org/10.17877/DE290R-17448

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2 Coding Manual for Data Extraction

CATEGORY	CODES / TYPE OF ENTRY	DESCRIPTION / INSTRUCTION
Author(s)	[text entry]	List the names of all authors.
Title	[text entry]	/
Year of Publication	[text entry]	/
Publication type	[single choice] ○ 1 Academic Journal Article ○ Title: _____ [text entry] ○ 2 Book Chapter ○ Title and Occasion of Book: _____ [text entry] ○ 3 Conference Paper/Contribution ○ Conference title: _____ [text entry]	/
Found per	[multiple choice] ○ 1 Database: Web of Science ○ 2 Database: ERIC ○ 3 Database: Teacher Reference Center ○ 4 Database: HAL Archive ○ 5 Handsearch: ICTMA Volumes ○ 6 Citation Searching: Cycle 1 ○ 7 Citation Searching: Cycle 2	How the article was found.
Country	[text entry] ○ 1 Turkey ○ 2 Germany ○ 3 Norway ○ 4 Indonesia ○ 5 Israel ○ 6 Italy ○ 7 Portugal ○ 8 Malaysia ○ … ○ 77 Unclear	Country or countries, where the study was conducted, if this is not mentioned, write “unclear”. If needed, add other countries with a continuous numbering.
Methodology	[multiple choice] ○ 1 Qualitative ○ 2 Quantitative ○ 3 Mixed-Methods	/

	○ 77 Unclear	
Sample size	[text entry]	Specific or approximate number, if not mentioned, write “unclear”. If only the number of classes is mentioned, use the estimation 1 class = 30 students.
Sample type	[multiple choice] ○ 1 Middle school students ○ 2 High school students ○ 3 University students ○ 4 Mathematics teacher ○ … ○ 77 Unclear	Middle school students: 10-15 years, grades 5-9 High school students: 16-18 years; grades 10-13 For participants of different ages who fall into more than one of the categories, all relevant categories are checked. If needed, add other categories with a continuous numbering.
Type of analysed data	[multiple choice] ○ 1 Written solutions of students ○ 2 Audio recordings of solution processes ○ 3 Video recordings of solution processes ○ 4 Screen recordings of solution processes ○ 5 Observation of solution processes and related notes ○ 6 Interviews and their transcriptions ○ 7 Answers in written test instruments ○ 8 Answers in questionnaires ○ 9 Solution processes of students in an app ○ 10 Reflection essays ○ 11 Modelling problem designed by pre-service teachers ○ 12 Sample solutions of modelling problem ○ 13 Video descriptions on how to solve the tasks ○ 14 Digital and printed 3D models from students ○ … ○ 77 Unclear	If needed, add other categories with a continuous numbering.
Considered digital tool	[multiple choice] ○ 1 GeoGebra ○ 2 Spreadsheets ○ 3 Internet ○ 4 Desmos ○ 5 Padlet ○ 6 Google Docs ○ 7 App ○ 8 Video material ○ 9 TinkerCAD	If needed, add other categories with a continuous numbering.

	○ 10 EdrawMax ○ 11 CurveExpert ○ … ○ 77 Unclear	
Modelling (sub-) competencies in focus	[multiple choice] ○ 1 Focused on general modelling competency ○ 2 Focused on all sub-competencies ○ 3 Focused on simplifying ○ 4 Focused on mathematising ○ 5 Focused on working mathematically ○ 6 Focused on interpreting ○ 7 Focused on validating ○ 77 Unclear	**1:** • Focus on overall, general modelling competency, without distinguishing sub-competencies. • Includes studies measuring general modelling competency quantitatively e.g., via solution rates. **2:** • Focus on sub-competencies, without preselecting specific ones. • Not all sub-competencies may be reported in the results. **3 - 7:** • Focus on specific sub-competencies of modelling, clearly defined by the study. • E.g. when this is indicated in the title or structure. If some sub-competencies are not mentioned only because no tool use was observed for them, but no prior restriction was made, it is still classified as Category 2.
Key findings regarding the influence of digital tools on modelling competency / sub-competencies	[text entry]	Description of the information the article provides on the influence of digital tools on modelling competency or sub-competencies, for example increase and decrease of the general modelling competency or a certain sub-competency.
Key findings regarding modelling activities that can be attributed to the use of digital tools	[text entry]	Description of the information the article provides about observed or described activities of students while solving a modelling task that are related to the use of a digital tool. In particular, it should be recorded which tool is used in which phase of the modelling process and for what purpose. Example: *GeoGebra is used in the step of mathematising to set up a digital mathematical model.*
Comments	[text entry]	This field can be used to record information, that was not requested in the previous fields but may still be important for the analysis process and answering the research questions.

3 Coding Scheme for Research Question 3

Modelling Step/Competency	Activity	Digital Tool
General	Receiving hints	Video material
Understanding	Receiving feedback (right/wrong)	MathCityMap app
Simplifying / Structuring	Looking at sample solutions	Actionbound App
Mathematising	Being supported in understanding of the task	Padlet
Working mathematically	Identify information and variables	GeoGebra
Interpreting	Drawing	TinkerCAD
Validating	Visualising	Spreadsheets
Exposing	Constructing	Google Docs
Unclear	Measuring	Desmos
	Calculating	Internet
	Researching	AR mobile math trail App
	Experimenting	EdrawMax
	Mathematising considerations (Implementation, Integration)	CurveExpert
	Presenting data or solutions	Unclear
	Operationalisation of data	
	Controlling results	
	Receiving instructions for simplification	
	Receiving inspiration for mathematisation	
	Exploring	
	Setting up a technological/digital (mathematical) model	
	Developing first solution drafts	
	Discovering and trying out different models	
	Unclear	