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Differences in the Requirements of Digital and Printed Mathematics Textbooks: Focus on Geometry Chapters

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Textbooks have always played an important role in mathematics education. Textbook tasks are widely used by students, so it is important to examine their requirements in order to identify the opportunities students have to learn mathematics. Publishers now produce both printed and digital versions of textbooks. While the requirements of the tasks in printed textbooks have been well examined all over the world, the tasks in digital textbooks are yet to be analysed and systematically developed. The research presented in this paper encompasses the analysis and comparison of the tasks in the printed and digital versions of the same mathematics textbook set. The examined set covers Grades 1 to 4 of primary education in Croatia. The aim was to find what task requirements are predominant in the printed and the digital textbooks, and to determine whether these textbook versions provide a wide variety of task features. In addition, the features and capacities typical of digital tasks, such as interactivity and dynamics, are examined. These task features are particularly important in geometry education for comprehending visual and dynamic geometrical objects and relations. The results show that both the printed and the digital textbook tasks have traditional requirements, with an emphasis on closed answer forms. Moreover, the new opportunities afforded by digital tasks are not realised. These findings reveal the potential of digital tasks as a new area to be explored and developed.

Keywords: textbook tasks, requirements, printed textbook, digital textbook, geometry

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Razlike v zahtevah digitalnih in tiskanih matematičnih učbenikov: poudarek na poglavjih o geometriji

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Učbeniki so imeli od nekdaj pomembno vlogo pri poučevanju matematike. Naloge iz njih učenci pogosto uporabljajo, zato je bistveno, da preučimo njihove zahteve in prepoznamo priložnosti, ki jih imajo učenci za učenje matematike. Založniki zdaj izdajajo tiskane in digitalne različice učbenikov. Medtem ko so bile zahteve nalog tiskanih učbenikov dodobra analizirane po vsem svetu, morajo biti zahteve digitalnih še preiskane in sistematično razvite. Raziskava, predstavljena v tem prispevku, vključuje analizo in primerjavo nalog tiskane in digitalne različice istega učbeniškega kompleta za matematiko. Izbrano gradivo zajema pregled učbenikov od 1. do 4. razreda osnovnošolskega izobraževanja na Hrvaškem. Namen je bil ugotoviti, katere naloge so prevladujoče v tiskanih in digitalnih učbenikih, ob tem pa določiti, ali te različice ponujajo široko množico funkcij. Poleg tega so bile preučene značilnosti in zmožnosti, ki so značilne za digitalne naloge, kot sta na primer interaktivnosti in dinamičnost. Te so še posebej pomembne pri poučevanju geometrije za razumevanje vizualnih in dinamičnih geometrijskih likov in odnosov. Rezultati kažejo, da imajo naloge tiskanih in digitalnih učbenikov tradicionalne zahteve s poudarkom na odgovorih zaprtega tipa. Mimogrede, nove priložnosti, ki jih sicer ponujajo digitalne naloge, niso uresničene. Te ugotovitve razkrivajo potencialne digitalne naloge kot novo področje, ki bi ga bilo treba raziskati in razviti.

Ključne besede: učbeniške naloge, zahteve, tiskani učbeniki, digitalni učbeniki, geometrija

Introduction

Textbooks have always played an important role in mathematics education. Textbooks that are consistent with the curriculum facilitate teachers' work and guarantee mathematical knowledge and exercises for students (Johansson, 2006; Love & Pimm, 1996). They provide security and convenience for teachers, students and parents. Research has shown that textbooks are mainly used by students as a source of tasks, particularly practice exercises (Pepin & Haggarty, 2001). A task is considered as a request for initiating student activity (Markovac, 2001), and working on tasks is the most common student activity in mathematics education (Kurnik, 2000). Therefore, textbook tasks provide opportunities for learning mathematics (Sullivan et al., 2013), they "potentially influence and structure the way students think and can serve to limit or to broaden their views of the subject matter with which they are engaged" (Henningsen & Stein, 1997). Consequently, it is important to examine their features and requirements.

In the past decade, new digital curriculum materials and e-textbooks have been developed. They include a number of new features that are not found in traditional resources. Digital curriculum materials can be transformative, with many dynamic and interactive possibilities; they can easily provide customised instruction and formative assessment, and often have links to multimedia resources and viral communities (Choppin et al., 2014). Choppin et al. (2014) provided a typology of digital curriculum materials concerning: (a) students' interactions with these resources; (b) curriculum use and adaptation; and (c) assessment. Similarly, Pepin et al. (2017) conceptualised three features of digital resources in terms of: instruction; assessment and reporting; and management. The authors regard digital curriculum resources as opportunities for changing instruction because of their potential "to provide stimulating and meaningful learning experiences for students, and motivating opportunities for teacher collaborative learning, including the enhancement of teachers' design capacity" (Pepin et al., 2017, p. 646). These new features refer to the whole learning space of digital curriculum materials (presentation spaces, navigation spaces, platforms, etc.), also encompassing the *tasks* in digital textbooks. Producing digital tasks has become a real challenge for textbook authors because e-tasks "can extend and amplify pedagogical features present in non-digital environments" (Leung & Baccaligni-Franck, 2017, p. ix). These challenges include enhancing interactivity and customisability through tasks, feedback and formative assessment (Choppin et al., 2014; Rezat, 2021), thus influencing educational processes and bringing "new educational dynamics" (Pepin et al., 2017, p. 646).

The representational and visual potential of e-textbooks may help students better understand mathematical ideas (Usiskin, 2018). This is particularly important for geometry education, which is strongly connected to visualisation. Interactions and dynamics in digital tasks may bring new opportunities to geometry education, which has been reduced in quantity within mathematics curricula in recent times (Glasnović Gracin & Kuzle, 2018; Kuzle & Glasnović Gracin, 2020; Mamanna & Villani, 1998). Contemporary thinking on geometry education involves organising it around certain fundamental ideas (Mamanna & Villani, 1998). In line with this, Wittman (1999) proposed the organisation of school geometry around seven fundamental ideas: geometric forms and their construction, operations with forms, coordinates, measurement, geometric patterns, geometric forms in the environment, and geometrisation.

In 2019, within a comprehensive education reform in Croatia, a new curriculum for mathematics was published (Ministry of Science and Education [MZO], 2019) based on student outcomes, real-world orientation and a problem-solving approach. The support of high-quality resources, including textbooks and IT resources, was identified as one of the key reform factors. Geometry content within the new mathematics curriculum contains the following concepts. First-grade geometry encompasses basic 2D and 3D shapes and patterns, straight and curved surfaces and lines, and points. Second-grade content refers to the line segment and its measurement, its edge points, length units, the sides of the square, quadrilateral, and triangle, and the edges of geometric solids. Third-grade geometry contains the line, the ray, the line segment and its measurement, length units, circumference, intersecting and parallel lines, and the circle. Fourth-grade geometry refers to angles, triangle types, the circle, radius, measuring area, units of area, and the square grid. This content, which is incorporated in learning outcomes, is surely reflected in textbook tasks.

With these considerations in mind, the aim of the present study is to analyse tasks within the geometry chapters in both the printed and digital versions of the same mathematics textbook set. In comparison to the research on tasks in printed textbooks, analysis of tasks in digital mathematics textbooks is rare. Therefore, it was important to develop an instrument for task analysis in digital mathematics textbooks.

Theoretical background

Five-dimensional framework for analysing textbook tasks

In order to analyse textbook tasks, Glasnović Gracin (2018) developed a five-dimensional instrument consisting of the following categories: mathematical content, mathematical activity, complexity, answer type and context. The basis for this instrument is a combination developed from two theoretical sources: Austrian standards for mathematics (Institut für Didaktik der Mathematik [IDM], 2007) and the framework provided by Zhu and Fan (2006).

Content. The content requirements refer to "finding out what mathematical knowledge a student should possess in order to solve a particular textbook task" (Glasnović Gracin, 2018, p. 1009). In primary grades, it encompasses arithmetic, geometry, measurement, statistics and probability, and patterns. Since the present study refers to geometry, within the content dimension we took the framework based on Wittmann's (1999) aforementioned seven fundamental ideas. These ideas were further developed by Kuzle and Glasnović Gracin (2020) as follows. (1) Geometric forms and their construction refers to different shapes and forms (e.g., points, lines, 2- and 3-dimensional shapes), which can be constructed or produced in a variety of ways. (2) Operations with forms refers to different geometry operations, such as translation, rotation, mirroring, dilation, etc. (3) Coordinates and spatial visualisation refers to describing locations using coordinates, and may also encompass positional relationships and spatial visualisation. (4) Measurement means describing geometric forms using units of length, area or volume, and also contains angle measuring and formulae for perimeter, area and volume. (5) Geometric patterns are patterns in which geometric objects are used. (6) Geometric forms in the environment refers to real world objects described with the help of geometric forms. (7) Geometrisation means mathematical non-geometric properties translated into the language of geometry (e.g., triangular numbers). These fundamental ideas may overlap in tasks, i.e., a task that contains one fundamental idea may refer to another one, too.

Activities. Mathematical activities in tasks refer to the question of *what* should be done in a particular task; for example, does the textbook task require the activity of computation or maybe drawing a figure, or giving a mathematical explanation (Glasnović Gracin, 2018)? This field is divided into: representations and modelling; calculation and operation; interpretation; and argumentation and reasoning (IDM, 2007). These activities are not hierarchically ordered. (1) Representations refer to transmissions of the given mathematical data into another type of presentation, while modelling means recognising relevant mathematical relationships from the given situation and representing the same problem in a mathematical mode (symbolic, graphical, etc.). (2) Calculation refers to conducting elementary computations. Operation concerns the conducting of computational or constructional steps. (3) Interpretation concerns recognising relations and relevant data given through mathematical representations and their understanding in the given context. (4) Argumentation means the description of mathematical aspects that speak pro or contra a particular decision. Reasoning is the sequence of true arguments that lead to a conclusion.

Complexity. Tasks may be put on different levels of cognitive complexity (e.g., Organisation for Economic Co-operation and Development, 2003; Zhu & Fan, 2006). IDM (2007) distinguished between reproduction, connections and reflection. Some items are simple and require the direct application of basic knowledge and skills, while others are more complex and require constructing and dealing with connections between a variety of concepts and rules in order to solve the problem. Finally, some items require reflecting on ideas that are not directly apparent from the posed problem (IDM, 2007).

Answer type. Based on a study by Zhu and Fan (2006), Glasnović Gracin (2018) distinguished between closed answer form, open answer form and multiple choice. Open-ended tasks refer to tasks with several or many correct answers, while closed-ended tasks have only one answer and can be easily validated as correct or incorrect. Multiple choice tasks provide a limited number of response options.

Context. The contextual features of a task refer to the extent of real-world experiences that are present in a particular textbook task. Glasnović Gracin (2018) distinguishes between tasks with intra-mathematical situations, tasks with realistic context and tasks with authentic context. Within this categorisation, intra-mathematical problems are unrelated to the real world, authentic tasks contain genuine real-life situations and data, and realistic tasks have contexts that imitate authentic situations (using fictive names and data).

Categorisation of digital task features

We conceptualise here several categories of digital task features given emphasis in the literature, such as interactivity, dynamics, personalisation, response form, feedback and cooperation.

Types of digital textbooks and their interactivity. Usiskin (2018) distinguished between three types of e-textbook forms: minimal, hybrid and exclusive digital textbooks. The minimal platform is simply a digitalised version of a printed textbook (e.g., pdf version) with some additional links. The hybrid platform refers to both the paper and electronic form with built-in features to provide links with video explanations, hints, additional exercises, software for manipulating objects, etc. The exclusively digital platform is designed wholly as digital material with social media interactive objects that are linked and can be combined. A similar classification is given by Pepin et al. (2016), who distinguish between the integrative, evolving, and interactive e-textbook. These classifications imply different task features; for example, whether the student should solve the task in his/her notebook or in the digital answer space provided.

Dynamic diagrams for exploring mathematics. Unlike static printed textbooks, digital textbooks provide dynamics that may help in exploring and better understanding mathematical concepts and dependences. Dynamic representations clearly show the process of transformation of figures, the change of function values as the domain values change, the effects of parameters, etc. (Usiskin, 2018).

Personalisation in learning. Digital materials may be customised to meet the individual student's learning needs as s/he progresses through the mathematical topics. The programme may select tasks based on the user's performance in assessment (Pepin et al., 2017). In addition, digital resources have the possibility to generate additional tasks. Such adaptive learning software may be used in diagnostic tests and in formative evaluations of the student's progress (Usiskin, 2018). In this way, the learning path refers to the evident non-linear way of working through the textbook tasks.

Task form. Digital tasks and the associated responses required from students can be presented in a number of forms. Some tasks are given in multiple-choice forms, others in a fill-in-the-blank form, etc. (Pepin et al., 2017).

Feedback. Digital resources and tasks have the potential to provide feedback and performance data to students and other stakeholders (Choppin et al., 2014). Feedback is considered as a powerful and influential factor in learning and achievement (Cohen, 1985; Hattie & Timperley, 2007). Schute (2008) provides a categorisation of different feedback types: no feedback, verification (right/wrong), correct response, try again, error flagging, elaborated (why the answer is/isn't correct), attribute isolation, topic contingent, response contingent, hints, misconceptions, and informative tutoring.

Cooperation. Digital resources have the possibility for the user to share their workspace with others and to enable collaboration (Pepin et al., 2017). This may be a very important feature for improving the learning process. The e-textbook tasks may foster this feature.

These features of digital textbooks raise the question of whether this potential is actually used in the current digital tasks provided for students.

Research questions

The aim of the present study was to determine which task features predominate in printed and digital textbooks, and whether the two versions of the textbook provide a wide variety of task features. Therefore, the following research questions were posed:

1. What are the differences between task requirements in digital and printed textbooks?
2. What additional task features are presented in digital geometry tasks?

Method

Sampling. The study presented in this paper refers to an empirical study using textual analysis. It encompassed the paper and digital versions of the most frequently used mathematics textbook set in Croatia for Grades 1, 2, 3 and 4 (Miklec et al., 2021a, 2021b, 2021c, 2021d). The analysis referred to all of the textbook tasks provided for practice and revision in the geometry chapters. Altogether, the analysis encompassed 600 textbook geometry tasks: 267 from the printed textbooks and 333 from the digital textbooks. The study took into consideration only the digital tasks in which the student should give their answer in the digital space provided, because such tasks contain at least some of the aforementioned digital task features.

Instrument for textbook analysis. Based on the theoretical background, two instruments for task analysis were established. The first refers to the aforementioned five-dimensional framework for analysing textbook tasks (Table 1). This instrument was developed from the framework by Glasnović Gracin (2018), focusing on geometry tasks in primary grades. The content strand focused on geometry; specifically, on Wittmann's (1999) fundamental ideas, which were further developed by Kuzle and Glasnović Gracin (2020). For the purposes of this study, the codes F1 to F7 (Kuzle & Glasnović Gracin, 2020) were slightly modified further for primary education (Table 1). The mathematical activities (Glasnović Gracin, 2018) were developed for this study by separating calculation and operation, and adding estimation with measurement and comparison. In this way, we sought to get a better insight into the activities required in geometry tasks of primary grades. As in Glasnović Gracin (2018), code H is used for mathematical activities (German: Handlungen), K for complexity (Komplexität), A for answer form and C for context.

Table 1
Five-dimensional framework for geometry task analysis, developed for the study

Dimension	Details and codes
Content (fundamental ideas of geometry)	Points (F1.0), 1-dim objects (F1.1), 2-dim objects (F1.2), 3-dim objects (F1.3) Operations with forms (F2) Positional relationships and spatial visualisation (F3) Measurement (F4) Geometric patterns (F5) Forms in the environment (F6) Geometrisation (F7)
Mathematical activity	Representations (H1) Calculation (H2) Operation (H3) Interpretation (H4) Argumentation (H5) Estimation and measuring (H6) Comparison (H7)
Complexity level	Direct application of rules and definitions (K1) Simpler connections (K2) Complex connections and reflection (K3)
Answer form	Closed (A1) Open (A2)
Context	Intra-mathematical context (C1) Realistic context (C2) Authentic context (C3)

The second instrument was developed according to the literature review on the categorisation of digital task features. Each category and its subcategory is defined by a code given in Table 2. *Dynamic diagrams* refer to tasks that require exploring geometry properties using dynamics. *Personalisation* in an e-task means that the exercise reflects a concern for the student's individual progression in learning based on his/her performance. *Cooperation* means that the task provides the possibility for users to share their workspace with others in order to solve the task. According to Pepin et al. (2017), assessment can be incorporated into programs in different ways and forms, such as multiple-choice questions or fill-in-the-blank responses. For the purpose of the present study, we developed seven categories of *task form*, for the better categorisation of all of the examined tasks: multiple-choice questions, fill-in-the-blank responses, matching, true or false, put in order, other closed forms and open-ended questions. *Feedback* codes are established according to Schute's (2008) categorisation: no feedback refers to situations in which a student responds to the given question, but there is no way of knowing whether or not the answer is correct. Tasks with feedback are further divided into the following components. Verification feedback means returning a simple right/wrong response. Correct response means giving feedback just for correct answers. Try again refers to the possibility of trying until the correct answer is given, while error flagging highlights incorrect answers in the task, but does not offer the correct answer. Elaborated feedback means giving an explanation of why a specific response was correct or incorrect. Hints/cues/prompts are part of elaborated feedback: they guide students in the right direction by giving them examples or recommendations on what to do next, for instance, but the correct answer is not explicitly given.

Table 2

Framework developed for the analysis of digital tasks (special features)

Dimension	Details and codes
Dynamic diagrams for exploring mathematics	Yes – manipulating objects of dynamical geometry (D1) No (D2)
Personalisation in learning	Yes (P1) No (P2) What type of personalisation? ____________________
Task form	Multiple-choice questions (TF1) Fill-in-the-blank responses (TF2) Matching (TF3) True or false (TF4) Put in order (TF5) Other closed forms (TF6) Open-ended questions (TF7)
Feedback	No feedback (F1) Verification (F2) Correct response (IF1) Try again (IF2) Error flagging (IF3) Elaborated (IF4) Hints/cues/prompts (IF5) Other (IF6)
Cooperation	Yes (COO1) No (COO2)

Procedure and exemplary analysis. The analysis of tasks in the selected textbook set was conducted using the instruments given in Table 1 and Table 2: the printed textbooks were analysed according to the codes given in Table 1, and the digital tasks by the codes from tables 1 and 2. The five-dimensional framework (Table 1) was firstly applied to all exercise tasks in both the printed and the digital textbooks in order to find the (mathematical) features of these tasks. Altogether, 600 tasks were examined by this instrument: 267 in the printed textbooks and 333 in the digital textbooks. Each of the tasks was coded into the corresponding category. This analysis was followed by the application of the framework given in Table 2, which was applied to the 333 digital tasks. Both analyses referred to the qualitative textual analyses, because the meaning of the text led to the appropriate code. The accuracy and reliability of the coding in both instruments was ensured by checking task samples by both authors. Figure 1 presents a task from the digital textbook (translation: Match the picture to the term). In Table 3 and Table 4, the exemplary analysis of this task is given. The coded data were further analysed using quantitative methods; specifically, finding the relative frequencies of codes within a particular category.

Figure 1

An example of a task from the digital textbook

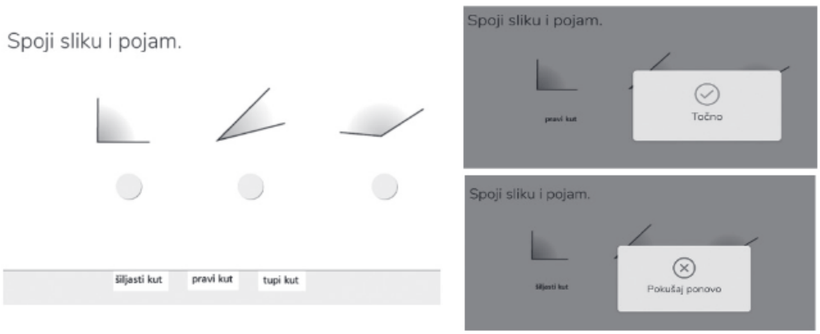

Table 3

Coding of the task in Figure 1 according to the framework given in Table 1

Category	Code	Description
Content	(F1.2)	2-dim objects
Mathematical activity	(H4)	Interpretation
Complexity level	(K1)	Direct application of rules and definitions
Answer form	(A1)	Closed
Context	(C1)	Intra-mathematical context

Table 4

Coding of the task in Figure 1 according to the framework given in Table 2

Category	Code	Description
Dynamic diagrams for exploring mathematics	(D2)	No
Personalisation in learning	(P2)	No
Task form	(TF3)	Matching
Feedback	(F1) (IF2)	Verification Try again
Cooperation	(COO2)	No

Results

The results section is divided into two parts. The first part, *Task features in printed and digital textbooks*, refers to the first research question, analysis of printed and digital tasks according to the codes given in Table 1, and their comparison. The second part, *Special features of digital tasks*, refers to the second research question and analysis of digital tasks according to the codes given in Table 2.

Task features in printed and digital textbooks

Printed textbooks. The results of task requirements in the printed textbooks are presented in Table 5. The overall findings indicate a lack of variety in task requirements.

In the *content* category, about a third of the analysed exercises referred to knowledge about 1-dimensional objects (straight and curved lines) and another third to 2-dimensional objects (F1.2). Tasks on geometric solids were underrepresented, with no such tasks at all in Grades 3 and 4. In line with this, examination of the curriculum (MZO, 2019) shows the dominance of two-dimensional objects and lines. Tasks that contain operations with geometric forms (F2), such as symmetry, and tasks with positional relationships (F3) and geometrisation requirements (F7) were also omitted altogether from the printed textbooks. These ideas are not highlighted in the geometry curriculum either. Measurement is present in about 20% of all of the geometry tasks in Grades 1–3, and 10% in Grade 4. However, length and area measurement are highlighted as important in the fourth-grade geometry curriculum (MZO, 2019). In line with the curriculum, geometric patterns (F5) are present only in the first grade, with a proportion of 19%. On the other hand, the curriculum highlights real situations (F6), while the findings from the textbooks show a lack of such tasks, particularly in Grades 3 and 4.

Table 5
Task requirements in the printed textbooks

Categories and codes		Grade 1 (n = 58)	Grade 2 (n = 36)	Grade 3 (n = 82)	Grade 4 (n = 91)	TOTAL (n = 267)
Content (fundamental ideas of geometry)	F1.0	8.62%	8.33%	0.00%	0.00%	3.00%
	F1.1	10.34%	41.67%	65.85%	20.88%	35.21%
	F1.2	15.52%	19.44%	17.07%	74.73%	36.70%
	F1.3	12.07%	8.33%	0.00%	0.00%	3.75%
	F2	0.00%	0.00%	0.00%	0.00%	0.00%
	F3	0.00%	0.00%	0.00%	0.00%	0.00%
	F4	20.69%	19.44%	19.51%	9.89%	16.48%
	F5	18.97%	0.00%	0.00%	0.00%	4.12%
	F6	15.52%	11.11%	1.22%	0.00%	5.24%
	F7	0.00%	0.00%	0.00%	0.00%	0.00%
Mathematical activity	H1	53.45%	50.00%	48.78%	56.04%	52.43%
	H2	0.00%	0.00%	17.07%	29.67%	15.36%
	H3	0.00%	0.00%	3.66%	0.00%	1.12%
	H4	44.83%	27.78%	2.73%	25.27%	28.46%
	H5	1.72%	5.56%	1.22%	6.59%	3.75%
	H6	0.00%	19.44%	12.20%	12.09%	10.49%
	H7	0.00%	0.00%	2.44%	2.20%	1.50%
Complexity level	K1	98.28%	77.78%	82.93%	63.74%	79.03%
	K2	1.72%	13.89%	17.07%	36.26%	19.85%
	K3	0.00%	8.33%	0.00%	1.10%	1.50%
Answer form	A1	93.10%	83.33%	92.68%	86.81%	89.51%
	A2	6.90%	16.67%	7.32%	13.19%	10.49%
Context	C1	53.45%	83.33%	90.24%	89.01%	80.90%
	C2	46.55%	5.56%	7.32%	5.49%	14.98%
	C3	0.00%	11.11%	2.44%	5.49%	4.12%

The results regarding the mathematical *activities* required reveal that half of the analysed geometry tasks in each grade require presentation activities (H1). The opposite activity, interpretation (H4), is present in 45% of the tasks in the first grade, while the tasks for other grades vary between 21% and 28%. Estimation and measuring (H6) are present in one fifth of items in the second grade, while argumentation (H5) is underrepresented in all of the examined grades.

The *complexity* category shows the predominance of simple tasks (K1) in all grades. Simpler connections (K2) increase in the printed textbook tasks from Grade 1 to Grade 4. The results also show the clear dominance of closed *answers* in the geometry chapters in all of the examined grades, as well as intra-mathematical tasks. Although 47% of all of the examined tasks in the first grade have a realistic *context*, this is underrepresented in all of the other grades (5–7%). There are barely any authentic tasks (C3) in the analysed textbook set.

Digital textbooks. The results of task requirements in the digital textbooks according to the five-dimensional framework are presented in Table 6. In terms of the *content category*, lines, two-dimensional objects and measurement are present in all of the grades, which is in line with curriculum requirements (MZO, 2019). However, points, which are highlighted in the first-grade curriculum, are minimally present in the e-tasks. As can be seen in Table 6, some content is not required in any of the examined e-tasks, such as operations with geometric forms (F2), tasks with positional relationships and spatial visualisation (F3), forms in the environment (F6), and geometrisation (F7). These ideas are not present in the Croatian curriculum for primary grades either, except for F6, which is highlighted as important (MZO, 2019). Geometric patterns (F5) are only present in the first grade (12%), in line with curricular requirements.

Interpretation (H4) is the most required *activity* in the digital tasks (from 45% to 81%). Representations and calculation are represented with 15% and 17%, respectively, in all of the e-tasks. Argumentation (H5) and operation (H3) are only present in Grade 4, and to a small extent. Estimation and measuring (H6) are found mostly in the second-grade e-tasks, but they are not present at all in the first and fourth grades (Table 6).

Table 6

Task requirements in the digital textbooks

Categories and codes		Grade 1 (n = 68)	Grade 2 (n = 20)	Grade 3 (n = 70)	Grade 4 (n = 175)	TOTAL (n = 333)
Content (fundamental ideas of geometry)	F1.0	1.47%	40.00%	17.14%	0.00%	6.31%
	F.1.1	8.82%	50.00%	54.29%	10.86%	21.92%
	F.1.2	23.53%	35.00%	8.57%	69.14%	45.05%
	F.1.3	33.82%	30.00%	2.86%	0.00%	9.31%
	F2	0.00%	0.00%	0.00%	0.00%	0.00%
	F3	0.00%	0.00%	0.00%	0.00%	0.00%
	F4	30.88%	250.00%	34.29%	21.14%	26.13%
	F5	11.76%	0.00%	0.00%	0.00%	2.40%
	F6	0.00%	0.00%	0.00%	0.00%	0.00%
	F7	0.00%	0.00%	0.00%	0.00%	0.00%
Mathematical activity	H1	19.12%	30.00%	12.86%	12.57%	15.02%
	H2	0.00%	5.00%	28.57%	20.57%	17.12%
	H3	0.00%	0.00%	0.00%	1.14%	0.60%
	H4	80.88%	45.00%	51.43%	63.43%	63.36%
	H5	0.00%	0.00%	0.00%	2.86%	1.50%
	H6	0.00%	20.00%	5.71%	.00%	2.40%
	H7	0.00%	0.00%	1.43%	0.57%	0.60%
Complexity level	K1	100.00%	100.00%	100.00%	94.86%	97.30%
	K2	0.00%	0.00%	0.00%	5.14%	2.70%
	K3	0.00%	0.00%	0.00%	0.00%	0.00%
Answer form	A1	100.00%	100.00%	100.00%	100.00%	100.00%
	A2	0.00%	0.00%	0.00%	0.00%	0.00%
Context	C1	44.12%	85.00%	87.14%	93.14%	81.38%
	C2	55.88%	15.00%	12.86%	3.43%	16.82%
	C3	0.00%	0.00%	0.00%	3.43%	1.80%

In terms of task *complexity*, the results revealed the dominance of simple e-tasks in all four grades, while connections (K2) are only represented by a very small percentage in Grade 4. Furthermore, the results show that the closed *answer* form (A1) is required in all of the examined digital tasks. Intra-mathematical *context* (C1) increases from the first to the fourth grade, while realistic context decreases. In the fourth grade, only a very small percentage of the digital tasks have an authentic context (C3).

Comparison of task requirements in the printed and digital textbooks. One of the aims of the study is to compare the task requirements in the printed and digital tasks. According to the total results (Tables 5 and 6), the *content* proportion of the printed tasks is greater for 1-dimensional objects, while there are more tasks with 2-dimensional objects among the digital tasks. Tasks containing the concept of points and solids are differently distributed over the grades in the printed textbooks and the e-textbooks. The printed textbooks contain points to a similar extent (8%) in Grades 1 and 2, while points are differently distributed in the e-tasks in Grades 1 to 3, with 40% in Grade 2. The proportion of geometric solids is greater in the digital than in the printed textbooks, but they are present mainly in Grades 1 and 2. Tasks with measurement (F4) are present to a greater extent in the digital than the printed tasks. Geometric patterns (F5) are present only in the first grade in both the printed and the digital tasks, as well as in the curriculum. It is interesting to note the similarity of ideas in both the printed and the digital tasks in the fourth grade: only lines, 2D objects and measurement are present in Grade 4. The curriculum covers these fundamental ideas, but also emphasises F6. Forms in the environment (F6) are present in only 5% of the tasks in the printed textbooks, while they are not present at all in the digital textbooks. There were no tasks that contain operations with geometric forms (F2), or tasks with positional relationships (F3) and geometrisation requirements (F7), in either the printed or the digital textbooks.

A comparison of the data (Table 5, Table 6) shows that the most required mathematical *activity* in the printed tasks is presentation (52%), while the same activity is present in only 15% of the e-tasks. On the other hand, interpretation (H4) is a frequent requirement in the digital textbook tasks (63%). Estimation and measuring (H6) is present more frequently in the printed tasks (10.5%) than in the digital tasks (2%). Calculation (H2) is present to a similar extent in the printed tasks (15%) and the digital tasks (17%), while argumentation (H5) is barely present in either the printed or the digital textbooks.

The *complexity*, *answer type* and *context* categories show similar proportions in the printed and the digital tasks analysed: the dominance of simple tasks (K1), closed answer forms (A1) and intra-mathematical tasks (C1). Open-ended questions (A1) are present only in the printed textbooks. Realistic context (C2) is present to a similar extent in the printed textbooks (15%) and the digital textbooks (17%), while authentic tasks (C3) are underrepresented in both sources.

Special features of digital tasks

The second research question refers to the special features and potential provided in the digital tasks. According to the results given in Table 7, almost half of the total number of e-tasks take the *task form* of a multiple-choice question (TF1), with the highest proportion in the third grade (60%). In almost one fifth of the digital tasks, the answer needs to be filled in (TF2), but there is a big difference in the proportion of these tasks in each grade: 30% in the fourth grade and less than 2% in the first grade. E-tasks with matching (TF3) are most common in the first grade, while true/false tasks are most common in the second grade. Put-in-order tasks (TF5) are present only in the first and third grades, but in less than 7% of the analysed tasks.

Verification *feedback* (F2) is given in 95% of all of the examined e-tasks. If the given answer is wrong, in half of the examined tasks, students can try to solve the task again (IF2). Try-again-feedback (IF2) is most represented in Grade 2 (65%), with about 50% in Grades 3 and 4, while in Grade 1 it is present in a smaller percentage of the tasks (30%). If the student's answer is wrong, some types of tasks give correct answers or error flagging. The correct answer (IF1) is most present in Grade 3 tasks, while error flagging (IF3) is most common in Grade 4. The results show that elaborated feedback (IF4), as well as hints/clues or prompts (IF5), are not present in any of the digital geometry tasks.

Table 7
Special features of the digital tasks

Categories and codes		Grade 1 (n = 68)	Grade 2 (n = 20)	Grade 3 (n = 70)	Grade 4 (n = 175)	TOTAL (n = 333)
Digital features	D1	10.29%	15.00%	0.00%	0.00%	3.00%
	D2	89.71%	85.00%	100.00%	100.00%	97.00%
Personalisation	P1	0.00%	0.00%	0.00%	0.00%	0.00%
	P2	100%	100%	100%	100%	100%
Task form	TF1	47.06%	45.00%	60.00%	44.00%	48.05%
	TF2	1.47%	20.00%	18.57%	30.86%	21.62%
	TF3	23.53%	5.00%	8.57%	18.86%	16.82%
	TF4	.00%	15.00%	8.57%	4.57%	5.11%
	TF5	7.35%	0.00%	2.86%	0.00%	2.10%
	TF6	20.59%	15.00%	1.43%	1.71%	6.31%
	TF7	0.00%	0.00%	0.00%	0.00%	0.00%

Categories and codes		Grade 1 (n = 68)	Grade 2 (n = 20)	Grade 3 (n = 70)	Grade 4 (n = 175)	TOTAL (n = 333)
Feedback	F1	10.29%	15.00%	.00%	2.29%	4.20%
	F2	89.71%	85.00%	100.00%	97.71%	95.80%
	IF1	16.18%	15.00%	31.43%	22.86%	22.82%
	IF2	32.35%	65.00%	54.29%	54.86%	50.75%
	IF3	16.18%	5.00%	25.71%	29.14%	24.32%
	IF4	0.00%	0.00%	0.00%	0.00%	0.00%
	IF5	0.00%	0.00%	0.00%	0.00%	0.00%
	IF6	7.35%	0.00%	0.00%	1.14%	2.10%
Cooperation	COO1	0.00%	0.00%	0.00%	0.00%	0.00%
	COO2	100%	100%	100%	100%	100%

Although *cooperation* and *personalisation* are presented in the literature as instances of the great potential of digital tasks, the present study showed that they are not utilised at all in the geometry tasks examined. Another advantage of digital textbooks is being able to provide *dynamic* diagrams for exploring for investigations and gaining a better understanding of mathematical concepts, particularly in geometry. However, dynamic diagrams for exploring (D1) are only present in Grades 1 and 2 in less than 15% of the digital tasks examined.

Discussion and conclusions

The study findings reveal the presence of traditional requirements in both the printed and the digital textbooks, with a predominance of simpler tasks with closed answer forms and intra-mathematical context. The results of the first research question, which points to the differences between task requirements in digital and printed tasks, suggest that presentation is the most frequent mathematical activity in the printed textbooks, while interpretation is most present in the digital textbooks. Furthermore, the proportion of measurement items is greater in the digital tasks than in the printed tasks. The second research question, which pointed to additional features of digital tasks, brought the following results. In the digital textbooks, a variety of answer forms are used and feedback is given in almost all of the digital tasks (95%). Nonetheless, the significant potential of digital tasks in areas such as cooperation, interactivity and dynamics is not represented at all in the analysed items. These results indicate that the examined textbook tasks do not provide a full range of features according to both instruments: the five-dimensional framework and the framework on digital features.

The analysis according to Wittmann's (1999) fundamental ideas shows that both sources provide a rather narrow picture of geometry through the given tasks. This finding is in line with the results presented in Glasnović Gracin and Kuzle (2018, 2019). It is also important to note that textbook tasks in Croatia are subject to curriculum requirements. Therefore, some fundamental ideas are not represented in the examined tasks because they are not required in the Croatian curriculum for mathematics (MZO, 2019); for example, symmetry, 3D objects, and geometric patterns. In this way, the content opportunities to learn geometry provided in textbook tasks are influenced by what is prescribed in the curriculum. These results call for a discussion on rethinking the Croatian geometry curriculum so that it is organised around more fundamental ideas. Consequently, printed and digital tasks would also provide a wider picture of geometry, helping students to create opportunities for a broader view of mathematics (Henningsen & Stein, 1997; Sullivan et al., 2013). Further in-depth research on the content requirements of Croatian mathematics curriculum is therefore needed.

Digital textbooks and the features they include may bring new opportunities to learning mathematics. According to Usiskin's (2018) conceptualisation of different types of e-textbooks, the digital textbook explored in the present study would be a hybrid resource because it contains both a paper and an electronic form, the latter with built-in digital activities. Ruthven (2017) claims that in such resources, the new digital media should provide different forms of interaction with the student and not "simply replicate the functionality" (p. 261) of traditional resources. However, the study presented in this paper revealed that the potential of digital geometry tasks in terms of interactivity, dynamics and collaboration is not being utilised. These findings are in line with the results presented in Pepin et al. (2017) about the features of digital curriculum resources: they are described as "still relatively rudimentary" (p. 652), with no emphasis on connectedness and lacking focus on the educative nature of digital resources. Therefore, generally speaking, the potential of digital textbook tasks have not yet been unlocked, and we can see here that the challenge in the future lies in developing the educational features of digital curriculum resources.

International implications

The study presented in this paper may be of interest to the international audience. It uses a five-dimensional framework for analysing the textbook tasks in primary grades, which is an extension of research conducted for middle grades (Glasnović Gracin, 2018). This framework has been used and cited worldwide, and the study shows that it can also be implemented for digital tasks. Furthermore, we developed a multi-dimensional framework for examining the special features of digital tasks, which can be implemented in different countries. This framework may contribute to raising awareness of the potential of e-tasks, as they have not yet been well investigated and developed (Pepin et al., 2017). This framework may be implemented for other mathematical disciplines, as well as for other school subjects and in different countries.

Limits of the study and future research

The study presented in this paper shows the features of printed and digital textbook geometry tasks; it also provides a framework for examining the special features of digital tasks. However, examining a larger number of textbooks (not just one textbook set, and not only from Croatia) may contribute to a better insight into the variety of task features provided in printed and e-textbooks. This study focuses on exercise tasks, but other parts of textbooks may also be examined, such as motivation or new content blocks. In addition, it is important to note that some parts of the instrument presented in Table 2 (special features of digital tasks) are more suitable for a larger set of tasks than tasks as individual items (e.g., the personalisation category). Future research would encompass an extension of the study to the role of teachers as mediators between tasks and students. The interplay between using printed and digital tasks opens new research spaces, particularly in relation to the untapped potential of digital resources. Moreover, the features of digital resources, such as dynamics, feedback, personalisation and cooperation, open up new ideas for students and research on student roles in learning mathematics.

It seems that the new technologies afford great possibilities for teaching and learning, but these possibilities have not yet been fully exploited. Task design is a well-developed branch of research in mathematics education; now is the time for deeper consideration of digital task design and its implementation in current resources.

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